PUBLICATION OFFICES:
168–177 POTTER BUILDING, NEW YORK.
Telephone Call: Murray 586. Cable Address: "Electrical," New York.

W. J. JOHNSTON, Editor and Publisher.
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Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed to
W. J. JOHNSTON, Publisher,
Potter Building, New York,
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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue: PAGE.
The Electric Gas Lighting Co.—Improvements in Electric Gas-Lighting Apparatus viii
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Vol. VIII. NEW YORK, DEC. 25, 1886. No. 26.

IT looks as though the meeting of the electric light men in Philadelphia next February will be an occasion of unusual interest and importance.

IT is now promised that the government telephone suit will get its next hearing in Boston. Perhaps the recent onslaught on two of the New England judges had some connection with the resolve to take the case into a jurisdiction where the Bell Company has been notably victorious.

ELECTRICITY, which has been the means of isolating a large number of the elements, has again been the medium of obtaining one of the most difficult elements to deal with, viz., fluorine. By electrolysing hydrofluoric acid at a comparatively high potential, nearly 40 volts, the acid is separated into its constituent elements, hydrogen and fluorine. The isolation of fluorine will probably give rise to a long list of new compounds, as the nascent gas seems to attack nearly all known substances with avidity.

THE offer of the Commercial Telegram Company to pay $500 for the discovery of the manner in which the bucket-shops get their quotations has not yet been taken up by anybody. It has not even been seconded by the Gold & Stock Company. The matter remains as mysterious as ever—except, of course, to the "insiders" who are working the oracle.

PRESIDENT HESS, of the Subway Commission, is responsible for the statement that Mr. Jay Gould says that on or about July 1, 1887, not a single Western Union pole will be seen in the city of New York. The declaration is not worth anything, either as a promise or a prophecy. The wires cannot go underground without conduits, and the conduits for them all cannot be finished by the time named. Some of the Western Union wires may stay on the elevated road structures, but a good many miles of subway will be needed.

THE support that electric motors for city street cars are receiving from such prominent and influential metropolitan journals as the *Times* and the *Commercial Advertiser* ought to be most encouraging to all interested in the subject. Yet the statements made by our contemporaries are no more than the facts warrant. The work already done by the electric motor justifies the strongest language of approval uttered about it, while every day witnesses improvements and new developments in this latest, but most practical, field of electrical application.

AT the last meeting of the American Association for the advancement of Science, Prof. T. C. Mendenhall noted the fact observed by him that resistance coils continue to give a current for some time after being disconnected from the battery. He suggested that the origin of this phenomenon might be looked for in a temporary polarization of the coils. In a note appearing in another column, a correspondent of a contemporary suggests that the currents observed are of thermo-electric origin, caused by the unequal temperatures at the junctions of the metals composing the coil and the mountings. The explanation is quite plausible, and may serve as a hint for the improved construction of resistance coils employed in accurate work.

AFTER the customary fifty years of experimentation, a Boston man has succeeded in discovering "a metallic composition capable of completely cutting off magnetic attraction." There can be no doubt about this, because a reporter saw an experiment performed in which a plate of the "composition" was placed between a compass and a magnet and no perceptible magnetism passed through the intervening composition; and other tests were not wanting to confirm statements as to the peculiar power of the composition. The inventor of the composition proposes to utilize it in the construction of motors, etc., such as will drive anything from a watch to a steamship. It grieves us to think that fifty years have been wasted in searching for a material the substitute for which is so widely disseminated in nature. It has evidently not occurred to the "inventor" that a sheet of iron interposed between the magnet and the needle in the experiment cited would have had the same effect as the "composition," and would have acted as the well-known magnetic "screen," which has already been put to various uses. Still we are anxious to know the ingredients of this wonderful composition.

THE discussion given in this issue on the paper read at the last meeting of the American Institute of Electrical Engineers, on "Electric Street Cars," shows that electricians are keenly alive to the unmistakable drift of public opinion in favor of electric traction within cities. The opinions of those who took part in the discussion were naturally uniform regarding the practicability of such a system, and only differed as to the best methods to adopt in order to carry it out. Thus the important question of the mode of connection between motor and car-axle occupied a large share of the time, and, indeed, it was well worthy the attention of those present, among whom were included some of the most prominent inventors and engineers now engaged in electric railway work in this country. There is nothing so reliable to base calculations on as actual experience, and of that sufficient has already been obtained to safely build upon, so that nothing now remains but to convince the layman of the feasibility and economy of electric railways.

TWO of the New York daily papers are finding fault with the local messenger service. In one of them, "Howard" has a two-column article, in which he says: "Tens of thousands of messages are sent which are delayed beyond the point of usefulness, productive of loss of money, of temper, of opportunity. So universally recognized is the slothfulness of the service that nothing more quickly raises a laugh upon the stage than an allusion to a messenger expedition." He then gives instances of long delay and wrong charges from his personal experience, and adds: "There is no use for explanation; we must have reform; we need the service; we are willing and able to pay for it." While the grievance may be exaggerated, there can be no doubt that the district messenger service might be made more rapid and efficient than it is. Its very usefulness is the reason why people complain when it is found wanting.

THE comments made by one of our gas contemporaries, on the recent meeting of the American Gas Light Association, tend to show that the neglect of the latter to discuss the most important question now before the gas companies was by no means in conformity with its best interests. The question whether gas companies shall undertake the furnishing of electric light, says our contemporary, "is one that must be largely met and decided upon before the ten months roll around that lead to another meeting of the American Association. The coming year will see far greater progress made by the electrical interests than the sage and sober chroniclers of 'electrical accidents' are dreaming of." Our contemporary has struck the key-note of the situation, and it follows up its admonition with good advice on this subject. We heartily indorse the remarks of our contemporary, which evidently has the best interests of the gas fraternity at heart. As for the electric light companies, we undertake to say for them that they will make things lively by active work.

ONE of the striking incidents of the telephone fight in Rochester is the part taken by the local "Board of Education." It appears that the telephone people put their housetop wires on a support upon the roof of the Rochester Free Academy, and other schools, without the permission of the board, although it is evident that the linemen must have had authority in each case from some one, or they could not have gone on the roofs. However, in view of the fact that the local telephone company, as "an arrogant monopoly," had thus "grossly insulted" everybody, the wires and fixtures have been peremptorily ordered off; while one member of the Board "was sorry he could not employ stronger language than the text of the resolutions." We know some of the telephone people in Rochester to be very quiet and unpretending men. It must stagger them to be spoken of as arrogant monopolists, as much as it staggers us to find such an absence of sweetness and light in an educational board. The "representatives of the people in the educational department of our municipal government" evidently feel that the eyes of the world are on them—and hence their hankering after strong language, no matter what the effect on the children in their charge may be.

WE have already drawn attention to the process of "electric welding" devised by Prof. Elihu Thomson; but his own article in this issue, based on his recent address before the Boston Society of Arts, gives fuller details in authoritative form of what can be accomplished by it. Judging from the manifest simplicity of the process and the extraordinary results obtained, as demonstrated by the specimens illustrated, its future is a very bright one. It puts at the command of the mechanic and engineer a means of uniting metals independently of their nature, and so that the joint shall be imperceptible, and as such it must be considered one of the most important advances recently made in electro-mechanical processes. Professor Thomson's article also brings out forcibly the great flexibility of electric applications and the ease of conversion they permit of. The very powerful currents required for the purpose are obtained from an ordinary alternating current machine through the medium of an induction coil or converter. In the latter case, a single turn of a stout bar of copper forms the primary, capable of delivering a current of 12,000 ampères at the points to be welded. It is curious to note, also, that even with this short length and single turn of the secondary, the self-induction is so great that vivid flashes are obtained upon rupture of the circuit.

THE employment of the magnet as a curative agent in medical practice has recently been brought out prominently by the alleged cures effected by its use. The latest report about these is to the effect that a French surgeon, M. Babinski, has tried to prove that certain hysterical symptoms could be transferred by the aid of a magnet from one patient to another. He took two subjects, one a dumb woman, afflicted with hysteria, and the other a female who was in a state of hypnotic trance. A screen was placed between the two, and the hysterical woman was then put under the influence of a strong magnet. After a few moments she was rendered dumb, while speech was suddenly restored to the other. M. Babinski also effected temporary cures of paralysis in the same manner. So far as proving the power of the magnet, this case leaves it doubtful whether there was any need of its presence at all. It will be remembered that some time since similar effects were obtained by the use of pieces of wood shaped like a magnet, to deceive the patient. In all the cases treated of which we are aware, the subjects have been of a highly nervous disposition, or in an absolute state of mesmeric trance; in other words, they were not possessed of their full, normal faculties. Hence these experiments can hardly be looked upon as anything more than exhibitions of mesmerism. They recall to mind strongly the experiment of Sir William Thomson, who, after placing the human head between powerful magnets, determined the "remarkable fact" that not the slightest effect was produced upon the subject.

Practical Notes Concerning the Construction, Use and Management of Storage Batteries.

BY A. RECKENZAUN.

(*Continued.*)

The foregoing is merely an example of a case where steam-power has to be expressly put down for the purpose of electric lighting, but there are numerous instances when the advantages of storage batteries outweigh the evil of waste entirely, where they come in not only as a great convenience but with absolute economy, always providing that their prime cost and maintenance are within reasonable bounds, which must and will be the case so long as the price of lead does not much exceed present rates and improvements in manufacturing processes continue to be effected. These favorable cases we may now proceed to consider.

First.—A case where the available source of power is small but continuous. There are thousands of factories, works or mills using steam-power throughout the day, and where a small increase of horse-power above the ordinary requirements will hardly be appreciated, and where the hours of darkness even in winter do not exceed three or four per day. There a dynamo may run off the common shafting all day with hardly any attention, and accumulate quietly in secondary batteries the energy requisite for lighting the shops in the evening or early in the morning. Again, there may be a small steam engine, gas engine or a small water-wheel or turbine running continuously for 12 or even more hours a day, the power of which might be inadequate to give light to a given number of lamps by direct application, but energy might be accumulated during the many hours when not otherwise wanted; this would virtually amount to double or treble the power of the source for the few hours when used for lighting or other purposes.

Secondly.—A case, local circumstances being favorable, of even greater importance than the first, where power from a natural source would be entirely running to waste, where, in consequence, we should have a decided gain even were the efficiency of the apparatus not more than 20 or 30 per cent. instead of actually 70 per cent. This is the case with rapidly flowing rivers and waterfalls in the vicinity of towns, industrial centres, or residences. In the United States some 14,000 h. p. are taken from waterfalls which formerly ran to waste, but now furnish the best of all illuminations, and on the Continent of Europe, also, water-power is similarly largely applied; but in none of these advantageous situations are as yet storage batteries used, although they might treble the capacity of the plant. This is principally because the improved batteries are not sufficiently known, and partly because they are still looked upon as being too expensive.

Thirdly.—A case where the stored energy is to be utilized when away and disconnected from the generator. Electric cars and electric boats illustrate this case.

These are old stories dished up afresh; when first told, five years ago, they were mere theories, exercises of enthusiasm: to-day they are realizations. To-day by this repetition we record facts. This makes all the difference.

(TO BE CONTINUED.)

Examination in Electrical Measurements.

The following are the questions in electrical measurements in the course of electrical engineering at Cornell University for the fall term of 1886.

1. Define the ohm; the ampère; the volt. Also, the legal ohm, ampère and volt.

2. Describe briefly the method used by the British Association committee, and afterward by Lord Rayleigh, for determining the true value of the ohm. Show what quantities must be observed.

3. Describe and demonstrate G. Carey Foster's method of comparing resistances by means of the divided metre bridge. Show how this may be applied to calibrate the bridge wire and determine its resistance per unit length.

4. In determining *H* by means of the Kew magnetometer, show how the length of the deflecting magnet is eliminated, and explain the corrections for temperature and induction.

5. Deduce the expression for the potential due to a magnetic shell, and reduce to simplest form involving linear quantities, for a shell with a circular edge, for a point on the axis of the circle. Also find the expression for the force in the direction of the axis on a unit pole.

6. What is the advantage of the Helmholtz over the single coil tangent galvanometer? Why is the distance between coils made equal to their radius? Describe the "Vienna method" of measuring currents.

7. Describe briefly the two forms of Ayrton and Perry ammeter. State their advantages and disadvantages. Describe the Siemens ammeter (dynamometer form).

8. How can potentials be measured in legal volts? Describe some of the portable voltmeters. How does temperature affect their indications? Why?

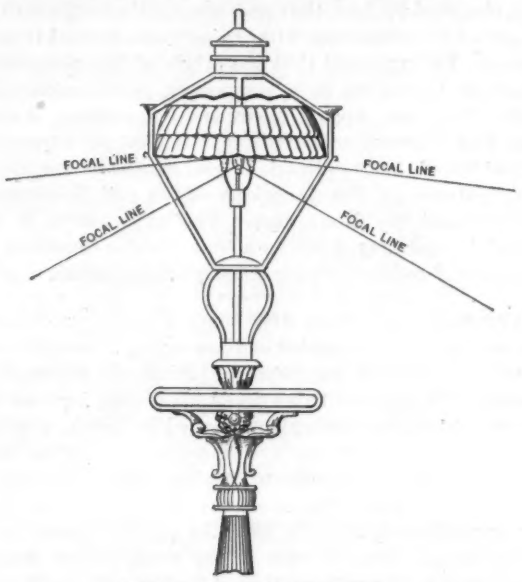
9. What can you say of the use of cells as standards of difference of potential? Give briefly the method pursued by Lord Rayleigh to determine the E. M. F. of Clark's cells.

10. How is the influence of errors of observation on a result to be determined? Explain the bearing of this upon the number of places of significant figures to be retained. Apply to the case of the measurement of current by a tangent galvanometer and suppose deflections can be read only to tenths of a degree.

Another Hint on Street Lighting from the Gas Man.

Writing to *Engineering* Mr. John G. Winton says: "Not until each lamp is turned into a minature light-house, distributing the rays of light from the gas by refraction or reflection, can we say that gas has been fully utilized. We have many lamps burning a great quantity of gas, giving off a powerful light, reflected in bright patches immediately under the lamps, while between the lamps is in comparative darkness. Among many plans we have devised, we have practically tested the double lens system with two jets, which throws beams of soft light right and left along the pavement and partially across the street; this plan is best suited for narrow thoroughfares. The lenses are placed closely together at the bottom, and should be 6 in. in diameter and upwards, the convex surfaces inclined downwards, and the light should be truly focussed and placed in front of the convex surface. The rays are refracted through the one lens, and refracted downwards through the other, then the rays from the one light are refracted through the other light, and *vice versa*.

"We have experimented with the druggist bottle in like manner, placing six jets all round a globe of glass filled with fluid, each refracted through that of the opposite one. In the three-focal lens this gave out great reflective power, and could be deflected at any angle by placing the light more or less above the horizontal axis. Were the globe surrounded entirely with jets of gas, we would have a ball throwing out rays of reflection all round the horizon. However, we reject the druggist bottle as a means of street lighting, and for narrow streets prefer the double



STREET LAMP REFLECTOR.

lenses throwing the beams of light up and down the street, while the gas of itself does its own legitimate duty. All round refraction through lenses may be arrived at as far as practicable, by subdivision, forming a globe of subdivided lenses, bringing their focal centres closely together; the light would be placed in the centre of the ring, and the rays from the one lens would amalgamate with the other. We prefer, however, to leave the light fully exposed in street lights. With that object in view we forward for your inspection a sketch of a street lamp, fitted up with two rings of concave subdivided reflectors; the bottom ring having the greatest range, while the top ring throws down the reflective power more immediately around the lamp-post to which we have shown the lamp fitted. In any situation commanding a large area, such as at railway stations, etc., the lamp should be placed at a considerable elevation, and care should be taken that the light given off by reflection is properly diffused, and not confined in narrow spaces.

"The top of the lamp is fitted with opal glass, which gives off the usual luminosity. We cannot afford to waste gas, so therefore we prefer to throw all the rays down on the surface of the streets in pyramids of reflection."

We may add that the electrician cannot afford to waste coal.

A Chance for Electric Motors.

The New York Court of Appeals has handed down a decision, the effect of which is to defeat the plans that had been formed for giving New York City about seventy miles of cable road all over the city. The decision is generally hailed with approval. A great opportunity is now presented for the introduction of electric motors, and it is evident that this view of the matter is gaining ground. The New York *Times* says editorially: "But if the cable plan be regarded aside from such considerations as these, it should be plain that it is not adapted to the needs of New York. The horse car system must go in the course of time, and the city will be relieved of a heavy burden when the stables and all the paraphernalia of a method of transportation depending upon horses shall disappear. But it should be followed by something better than cables. The rapid development of electrical science as applied to problems of transportation leads us to believe that th horse will make way for the electric motor. Such a change is greatly to be desired in a city like this." * * * "The people can look to electric motors for more satisfactory service on lines where horses are now used. They can look to cables on such lines for nothing but vexation. The defeat of the cable company should put an end to the cable folly in this city, and direct the attention of local transit companies and inventors to the possibilities of electric service."

A Subway Injunction from Winter.

At the meeting of the New York Subway Commission on Dec. 17, it was decided that there would be no more work on the conduits this year, as winter has set in, but Commissioner Gibbens introduced resolutions providing for the speedy and extensive resumption of work in the Spring. On his motion it was ordered that Assistant Engineer North be retained at a salary of $200 per month. Commissioner Gibbens then introduced a set of resolutions directing the engineer to prepare a map of the city showing the main lines of electrical conductors as they now exist, the routes of subways which ought to be undertaken upon the return of suitable weather, and to get from the electrical companies suggestions as to the routes and amount of space required, as well as the mode of distribution desired and the estimated increase of space likely to be wanted. In view of the fact that some companies feared the commission might turn them out of their allotted spaces after they were once occupied, it was resolved that the board would use its utmost power to protect companies complying with proper regulations in the enjoyment of any conduit rights which might be granted them.

A permit was granted to renew a line of poles from Fifty-eighth street and Tenth avenue to Yonkers, to meet the wants of a telephone service to Boston. Only a temporary permit was granted between Sixth and Tenth avenues, on Fifty-eighth street. The commission will insist upon an underground conduit on that street.

The annual report of the Brooklyn Electrical Subway Commission shows that during the past year 65,000 feet of underground conduit have been completed, into which there had been drawn, on Dec. 13, 1,121.3 miles of wire. Thus far 82.6 miles of aërial conductors have been taken down, and the work of removing the telephone wires from Fulton street and the neighborhood of the City Hall is to commence in a few days.

The Commissioners say that the Baltimore & Ohio Telegraph Company alone has taken no steps to place its wires under ground. With regard to the electric light conductors, the board has found no device which would enable wires carrying arc-light currents to be successfully operated in the same conduit with telephone and telegraph conductors. An immediate attempt to put underground all the police and fire wires of the city is declared inadvisable.

Effluviography.

This name has been applied by M. D. Tomasi to the effects produced by the silent discharge upon a sensitized gelatine-bromide plate. After an exposure of some minutes' duration an image may be obtained from an electrified body, although (if we understand the author aright) the potential may not be high enough to give any sign of light, and when all other light is excluded. The image may be developed in the usual manner. M. Tomasi considers that the silent discharge produces the same effect as the ultra-violet rays, and may form a connecting link between the two extremes of the spectrum, consisting of what may be called "electric rays."

The New Field Sextuplex.

To the Editor of The Electrical World:

SIR: Referring to your article published in the issue of Nov. 27 regarding the new Field sextuplex, the whole thing practically is nothing more or less than an ordinary quadruplex until we reach the addition of the vibratory portion. From the fact that a dynamo is used for this also, I infer that the vibratory currents are alternatingly positive and negative. Now I want to know if it is necessary that it should be so; or would an ordinary vibrating instrument—with suitable connections, inserted in the circuit of an ordinary main battery, so that an intermittent current be sent to line, say of positive electricity—answer the same purpose as this small dynamo? If so, this system might be adopted in offices where there are no dynamos without any extra trouble, or if a vibrating "pole-changer" were constructed in this case, would the vibrations be sufficiently rapid? X.

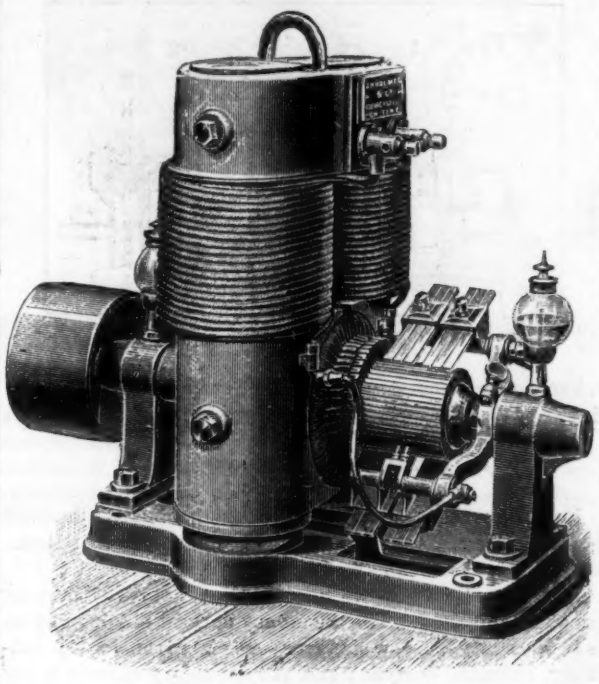
MONTREAL, CAN.

[These remarks presuppose that the apparatus is identical with existing quadruplex arrangements. By following out the connections, it will be seen that such is not the case. It is only by using the dynamo arrangement with its low internal resistance that sufficient margin is obtained—together with non-interference by key contacts—to allow of another transmission. Should the third side of the sextuplex be attempted with a battery it would be found that the great internal resistance of the cells, together with the difficulty of keeping the contact points of the vibrators in order, would render such a device inoperative.—EDS. E. W.]

The "Castle" Dynamo.

This is the name given to a machine which has been brought out in England, and which presents a neat and compact design. In the new dynamo, which is built in several sizes by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, the cores of the field-magnets are of well annealed wrought iron bars which are bored near the ends to receive the armature, and castings are closely fitted on to provide the requisite polar extensions, so that the lines of force at the poles nearly all pass through wrought iron. At the top the bars are joined by a very massive cast iron yoke which is so well connected magnetically that when the machine is working there is scarcely any exterior magnetism perceptible in its neighborhood. The armature is constructed of thin charcoal iron plates supported by a special arrangement which truly centres the core and secures that exact balance so necessary to the steady working of the machine, at the same time leaving the interior open to free ventilation. Only a single layer of conductor is wound on the armature and owing to its special section, these machines, we are informed, give the greatest possible output for their size. The brush holders are arranged so that the brushes may be placed out of contact with the commutator by merely pulling them back without altering the adjustment of the springs. The number of parts in the commutator is large and there is no sparking at the brushes.

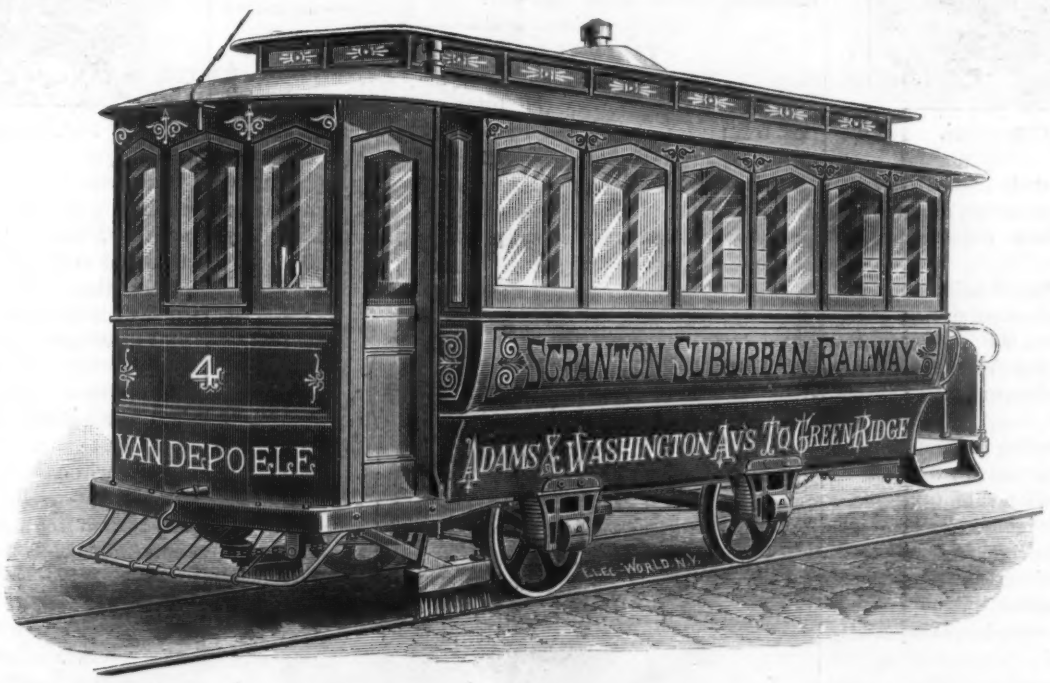
One of these dynamos has been working for a year in a mine, where it runs without stopping from Monday morning to Saturday night, and without showing any signs of undue heating or wear.



THE "CASTLE" DYNAMO.

The Scranton Electric Railway.

The operation of the Van Depoele electric railway in Scranton, Pa., continues with unabated success, and has aroused considerable enthusiasm as well as interest in the entire Susquehanna valley. Coal is so cheap in that region that the item of fuel cost is almost a vanishing quantity, and hence the application of electricity to the propulsion of cars finds a particularly favorable field there. We have in former issues given the details of the system, and need only present in this number an illustration of the car as it appears on the track. The motor, which has also been described by us, is situated on the front platform, where it is inclosed in a cabin together with the attendant. Curiosity impels most passengers to approach very closely to the front compartment, and to prevent the possible magnetization of their watches the interior of the cabin has been lined with sheet iron, which serves as a magnetic screen. Owing to the successful operation of the road—of which we are able to speak ourselves from personal observation—another car has already been ordered.



STREET CAR ON VAN DEPOELE ELECTRIC RAILWAY, SCRANTON, PA.

Gas and Electricity.*

In one respect, the recent meeting of the American Gas Light Association fell far short of what it should have been. There was no discussion worthy the name upon the greatest living question before the gas world—the present and future bearing of the electrical interests upon the gas interests. There was a studied attempt to pass the great question, and it was passed, well-nigh silently. There was a laughing attack made upon the photometric power of the electric incandescents, in the talk ensuing Mr. Boardman's able paper, but even this was quickly turned into an attack upon another interest. The greatest question with which the Association should have grappled was let alone.

Such treatment of a living issue comes only from one of two causes—apathy or fear. Either of these is inexcusable. Properly introduced and properly handled, the discussion of the relations which the two interests bear, and are to bear towards each other, would have been most fruitful in good results. The experience of some would have well served for the future guidance of others, and the hunger of many a weaker brother been allayed by the crumbs of wisdom and good advice that would have dropped from the lips of those who knew. It was a poor plan that shelved this matter for things of lesser importance.

For the question is one that must be largely met and decided upon before the ten months roll around that lead to another meeting of the American Association. The coming year will see far greater progress made by the electrical interests than the sage and sober chroniclers of "electrical accidents" are dreaming of. Inroads into the gas fields will be made to a serious extent, unless such be promptly and efficiently met. How to meet these is the question on which the experienced members of the American Association should have advised their brethren. The work undone has been left to others, and, so far as devolves the duty on us, we are determined that every gas man who reads shall know his danger and the way of escape.

There is a way of escape that is both honorable and, in most instances, easy. This is to recognize the lighting interests as one, and, instead of entering into a combat that will probably end in mutual disaster, to enter into a compact that shall jointly serve the twin interests.

There is no need of repeating old arguments here. It is common fact that the electric arc, at least, largely helps the domestic consumption of gas, and in many cases, where the street lighting has been lost to a gas company, its annual output has still shown a larger increase than in any previous years. How much better, in such cases, to make this increase in output, and still own the street-lighting plant? It takes little reason on the part of those who can reason to see the clearness of this. Nor does it take much more reason to see the way to such consummation.

The electric lighting companies are antagonistic to the gas interests, in a great measure, because the latter originally forced such a condition of things. There are those, supposably interested in the well-doing of the gas companies of the country, who have been holding their rush-light so close to the eyes of many of the older gas managers that the latter have failed to see clearly beyond, and have trusted in the assertions of a big breath that it would yet prove an easy matter to whistle electricity down the wind. As we have had occasion to say before, air gas will not do as a means wherewith to combat electricity, and wind alone is a poor weapon. The misguided gas managers are finding this out, and, with purpose well concealed, there are to-day not a few who have openly denounced the electric light, furtively making terms for that union of interests in their own cases that we openly advocate for all.

The electrical managers are becoming aware of the benefits arising from a union of interests, and they will not be slow to embrace fair opportunities. But we do not advise such a union as will necessitate a vast watering of stock and a holding up of a high price for gas to secure payment of dividends on fictitious values. There are instances wherein such procedures are, in greater or less extent, necessary; but these are the exceptions and not the rule. What we advocate is the installation on the part of every gas company of its own electrical plant. Begin first with an arc system, following up, as convenience may dictate, with the smaller lamps, thus giving consumers the choice of means for illumination and holding all the vantage ground within the company's grasp. In very many cases this can be accomplished without inflation of stock or issue of bonds; and we need not state the effect upon the dividend-earning power of such a company.

Will the electrical interests fall in with such a plan? Well, where they do not, a contest between an established gas company and a newly-organized electric lighting company, for the electric-lighting of a city or town, would last only until the latter company tired of a losing game. But the answer to the question can be more plainly given. The electrical interests will fall in. Our news columns show that one electrical company has taken advanced ground upon the question, and not only is openly working in union with the gas companies, but has secured some of the latter as its sectional agents. No one will question the fealty of the leading spirit of the St. Paul Gas Light Company, and this company is acting as the agent of the American Electric Manufacturing Company, for the northwest. It is due to Mr. Goff, President of the American Company, to say that this plan of a complete union of the gas and electrical interests is original with him, and that he is thus far alone in his advanced position, but he cannot so remain. His success has been so marked and his mode of approaching the gas companies so free from threats or demands, that the roll of companies that are falling in with his proposition, as published from time to time, must needs induce others to follow in the path he has marked out. Some of these will have to change their methods considerably to be able to approach with plausibility the gas companies they are now antagonizing; but the changes will be made, and we shall see the olive branch held out all along the line.

Will the gas companies accept? The wise ones will; the foolish will—do as they please. The future of many a gas company lies largely in the decision of this problem during the coming year. We believe there is but one way to meet this question, where such a way is possible, and there are few cases wherein it is not possible.

One thing is certain. The gas interests shall know what can be done, and none of the "might have beens" shall be traced to default of ours. We are here to remain, and the flag we raise is the banner of peace and prosperity for the interests we represent. We have no fear but that the progressive men of the gas fraternity will aid us in our endeavors to turn a common woe into a common weal.

* *Light, Heat and Power.*

Another Telegraph "Consolidation" Story.

A special dispatch of Dec. 16 from St. Paul, Minn., says: "Early this week it was announced that John W. Bingham, of New York, was in the city, and as it was understood that he was a confidential agent of Jay Gould, the rumor at once became current that he was here looking after the new North American Telegraph Company. From here Mr. Bingham went to Fargo, Dakota, and from a resident of that city it was learned to-day that he is in the West feeling the way for a possible consolidation of the Canadian Pacific with the Western Union lines. A scheme has been on foot for some time to extend the Canadian system to Fargo, then to join with the Western extension of the North American lines controlled by St. Paul and Minneapolis capital. This line in turn connects at Chicago with the Baltimore & Ohio system, and the Bennett-Mackay cable. Should the gap be closed by a union of interests and the building south to Fargo of the Canadian Pacific line, and west to Fargo of the North American, it would make an independent system covering the principal cities between the Atlantic and Pacific. Mr. Bingham is now in the Northwest to ascertain the possibility of the carrying out of such a programme. It is said that he is commissioned by Mr. Gould, in case it is necessary to prevent the consummation of such a scheme, to pay handsomely for a controlling interest in either the North American or the Canadian Pacific.

Margate, England.—It is intended to build an electric railway from the foot of Margate jetty to Westbrook, Westgate and New Town. Margate is one of the largest and most popular of English south coast watering places. Each section of the line will, as far as practicable, be laid with double lines of rails of narrow guage (3 feet 6 inches), and the cars will be driven by means of accumulators. Each car will be constructed to carry from 30 to 40 passengers, and open cars will be available for fine weather.

Fluorine Produced by Means of Electricity.

One of the most important advances made in chemistry is that recently effected by the distinguished French chemist M. H. Moissan, who has succeeded in obtaining fluorine in its elemental state. Heretofore fluorine has only been known as combined with other elements, such as with hydrogen in hydrofluoric acid, or with calcium in fluorspar; but by the employment of electrolysis M. Moissan has succeeded in obtaining it in the free, elemental state by decomposing hydrofluoric acid.

Our illustration, Fig. 1, taken from *La Nature*, shows a section of the apparatus employed for the purpose. The hydrofluoric acid is introduced into a platinum U-tube, the two branches of which are closed by stoppers of fluorspar (which, like platinum, is not attacked by hydrofluoric acid). The platinum electrodes pass through the stoppers, and the whole is covered with shellac, as shown in detail in Fig. 2.

In order to obtain the pure fluorine successfully it is necessary to have the hydrofluoric acid very pure and free from water, and hence great care must first be taken in preparation of the hydrofluoric acid itself. The latter is prepared by subjecting the fluorhydrate of fluoride of potassium to distillation in a retort, and condensing the fumes of hydrofluoric acid liberated in a tube placed under ice, as shown in Fig. 3.

The hydrofluoric acid being prepared, it is introduced into the U-tube, which has outlets for the escape of the gases formed, being submerged in a cooling mixture of chloride of methyl. Fig. 4, having a temperature of — 23

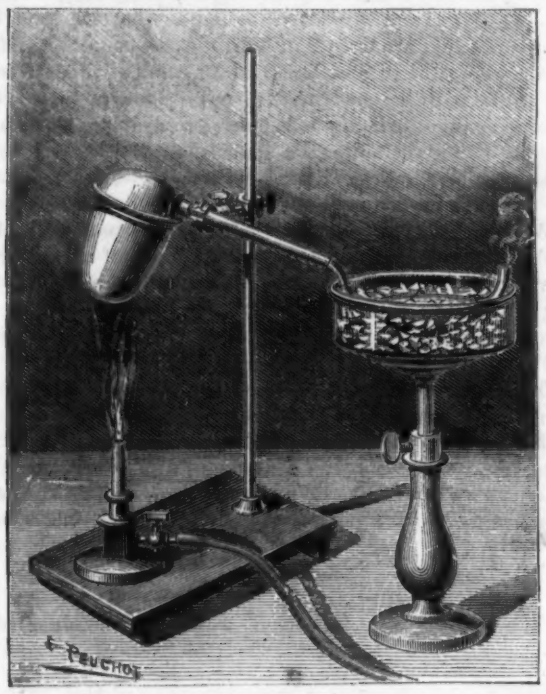


Fig. 3.—Fluorine by Electrolysis.

degrees centigrade. A current is then passed through from a battery of 20 Bunsen cells in series, an ampèremeter being in circuit, so as to show the strength of current.

If by accident or design the hydrofluoric acid contains a small quantity of water, ozone is liberated at first at the positive pole. As the decomposition of the water in the acid continues, the conductivity of the liquid rapidly decreases. With absolutely anhydrous hydrofluoric acid the current ceases to pass entirely.

In order to render the liquid conducting without the use of water, a small quantity of fluorhydrate of fluoride of potassium is added. The decomposition then takes place regularly. At the negative pole hydrogen is disengaged. At the positive pole a colorless gas, fluorine, is disengaged, in which silica burns with brilliancy and is transformed into fluoride of silicon; and many other substances are decomposed in its presence, organic compounds especially being violently attacked.

Railway Telegraph Lines.

The entire morning's session of Dec. 14 of the House of Representatives committee on post-offices and post roads was occupied in the reading of the report of Representative A. J. Warner, of Ohio, on the obligations of the subsidized railway telegraph lines, the principal points of which are as follows:

First—That the obligation to construct, maintain and operate a telegraph line is the same as the obligation to construct, maintain and operate a line of railroad.

Second—That a railroad company cannot relieve itself of this obligation, and cannot transfer it to any other company.

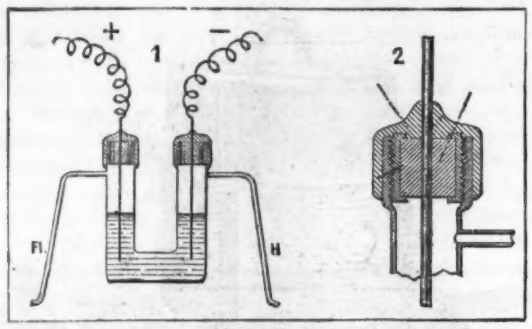
Third—That as public aid can be granted only for public purposes, such telegraph lines, as well as railroad lines, must be operated for the equal benefit of all persons, companies or corporations, without discrimination in favor of or against any one.

Fourth—In order that all may enjoy equal facilities, privileges and use of such telegraph lines, it is necessary that the same facilities and terms as to the reception and transmission of messages should be extended to the telegraph lines that are granted to another—that in this matter there should be no discrimination.

Fifth—The right of the Western Union, or any other telegraph company, to construct and operate lines of its own to the Pacific coast is not questioned, but it is held that the construction of such lines cannot relieve the railroad companies from the obligation to maintain lines themselves, as required by the several acts.

The penalties prescribed by the act of June 20, 1874, as to railroads, are made applicable to telegraph lines as well.

The report was ordered to be printed, and will be



Figs. 1 and 2.

taken up for discussion by the full committee at an early day.

Polarization of Resistance Coils.

Regarding the polarization of resistance coils observed by Prof. T. C. Mendenhall, and noted in these columns recently, Mr. F. C. Van Dyck writes to *Science*:

With my rheostat I fail to obtain any "reverse" current properly so called. The secondary current obtained by us is in the same sense, whichever sense is given to the primary, charging current; and the secondary current is not in the same sense in all the coils.

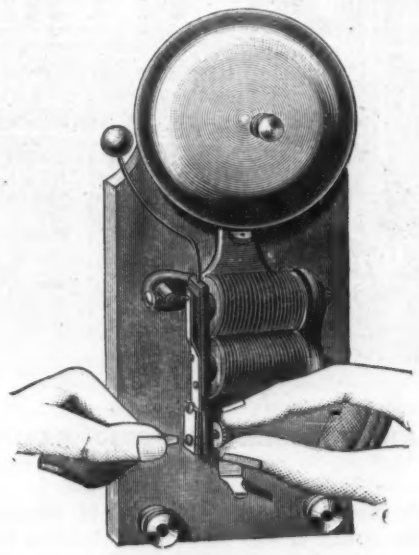
This rheostat is constructed with brass mountings and German-silver coils; hence I infer that the main cause, at least of secondary current, is unequal heating of the junctions of coils with mountings.

Since we obtained galvanometer deflections of equal amount, as well as in the same sense, for both senses of primary current through the rheostat, we failed to observe any polarization effect by difference. It may be that thermo-electric effects at junctions of copper conductors with brass terminals happened to mask the polarization in this case, though we could not believe it probable.

If my explanation of secondary current be correct as far as it goes, would it not be well to make rheostat coils and mountings of the same material?

The "Victor" Box Bell.

Our illustration shows the interior of a new vibrating box bell recently designed by the Electric Gas Lighting Company, of Boston, Mass. The working parts of the bell are attached to an iron bed plate, so that any warping of the base-board cannot affect the adjustments. An important attachment is the compound spring-adjusting key,



The "Victor" Bell.

by means of which the armature is adjusted to a strong or weak battery current. The illustration shows the manner in which the adjustment is effected.

The Lighting of Underground Railways.

For some time back the question of the lighting of the tunnel of the Underground Railway, at Glasgow, has occupied the attention of the directors of the North British Railway, and various modes of solving the difficulty have been suggested to them. A highly interesting experiment with the method which has found most favor with the management was made recently. This is termed the "Improved System of Electrical Train Lighting," and is the invention of Mr. Thomas P. Carswell, of the engineers department of the North British Railway. There is a central rail, along which the current is sent, raised a little above the level of the permanent rails, while on each of the carriages are contact pulleys which, coming in touch with this middle rail, convey the current to the incandescent lamps fitted up throughout the train. An electric rail has been laid and on this a long and complete train of first and third class carriages which have been furnished with the necessary apparatus was subjected to test. The experiment was highly successful. The train was run backward and forward between the two stations, and as each of the carriages emerged from the tunnel at either end, the lights went out in regular succession, while, when the tunnel was re-entered, each carriage again in regular succession brilliantly lighted up as contact was made between the pulleys and the middle rail. It is expected that a train with the new system of lighting will be put on for the public service immediately.

Professor Blyth's New Galvanometer.

Professor James Blyth, F. R. S., has devised a galvanometer, whose deflections are proportional to the current strength whatever their range. This is an improvement on the ordinary galvanometers, inasmuch as these do not give readings strictly proportional to the current strength when the deflections are large. The new apparatus is similar in principle to the device of Faraday for showing the continuous rotation across the lines of magnetic force of a horizontal radial conductor carrying a current and having slipping contacts at its centre and circumference. It consists of two bundles of magnetized steel wires made

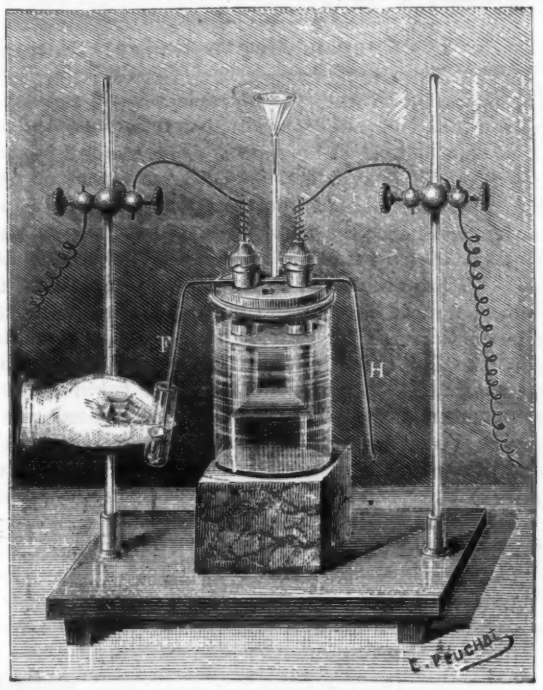


Fig. 4.—Fluorine by Electrolysis.

in the form of cylinders having narrow axial holes. These are fixed with their axes in the same vertical line, separated by a narrow gap, and so that the north poles of the one set of magnets face the south poles of the other. In this gap there is a sensibly uniform magnetic field, with vertical lines of force. In the gap there is a thin circular disc of vulcanite having a central mercury cup surrounded by a concentric mercury cup at a short distance from it. A stout brass rod, having a thick piece of copper wire rigidly attached at right angles to its lower end, is so placed that its lower end dips into the central mercury trough, while its upper is suspended from a long, fine torsion wire of steel or silver. The outer end of the copper wire is bent down so as to dip into the concentric mercury cup. Stout copper wires are led from the mercury cups to terminals on the base of the instrument, and when the current is brought by these terminals through the copper wire it moves round in the magnetic field. The vertical brass rod acts as an axis for it, and carries a long pointer at its upper part, which indicates the deflection of the copper wire or radial conductor on a suitable scale of equal divisions, which may represent ampères. The whole apparatus is inclosed so as to shield it from air currents. The turning moment of the electro-magnetic force on the indicating axis is balanced by the torsional moment of the wire. Thus, let

i = the current strength.
a = the length of the radial wire.
N = the magnetic induction.
A = the torsion constant.
θ = the angle of equilibrium.

Then,

$$\frac{1}{2} i a^2 N = A \theta \text{ ; or } i = \frac{2A}{a^2 N}\theta,$$

which shows that the current is proportional to the angle of deflection. In the actual apparatus the mercury cups are made on the principle of the button-hole ink bottle, so as to prevent the mercury from being spilled when the instrument is moved about or knocked over.

The Auburn Electrical Supply Company, of Auburn, N. Y., has been organized by Messrs. J. C. Timpson and J. F. Adams. It will deal in general electrical supplies, and is making a specialty of the electric "window tapper."

An Electro-Optical Baton.

M. J. Carpentier has introduced into the Grand Opera-House at Paris a new apparatus for transmitting the beats of the musical conductor to choristers or instrumentalists placed in the scenes where they cannot see the conductor himself. In short the apparatus transmits to a distance the indications of rhythm, and enables a musical conductor to guide musicians who are out of sight. M. Carpentier has employed a system of optical illusion for this purpose. Upon a black panel two furrows are made forming between them the angle ordinarily described by the baton of the *chef d'orchestre*. In each of these furrows a square rule is mounted so that it can rapidly pivot round its axis for a quarter of a turn, and show alternately two of its faces. Of these faces alternately apparent, one is black like the panel and the other is white. When by a sudden movement the white face is replaced by the black face, the rule seems to disappear. If at the same time the inverse movement is produced for the second rule, that appears. The effect which goes alternately to the rule which is white, [illegible] to see a single rule move between the two extreme positions. A simple mechanism, of which the principal organ is an electro-magnet, allows the simultaneous pivot movement of the two rules, and the conductor has only to press on a button or pedal in following the rhythm, in order to work the optical apparatus. The effect is based on the persistence of impressions on the retina.

Western Union Wires Underground in Broadway.

During the past week the Western Union Company have drawn into their Broadway conduits fifty-five miles of wire in three "Waring" underground cables of the Standard Company. These were two 25-wire bunched cables and one 5-wire anti-induction cable, the latter for the use of the city fire and police departments. The conduit consists of two 5-inch iron pipes laid two and a half feet deep under the west line of car tracks of the Broadway surface railroad; hence it was necessary to begin laying the cables after the street cars had ceased running for the night—after two o'clock—and to stop work before five A. M., when the first morning car was due to arrive. The greatest quantity laid in one night—about 2½ hours working time—was 4,200 feet, being 3 lengths of 1,400 feet. All of the present work was between the Western Union building at Dey street and the Howard street manhole. The manholes along the line of the conduit are a little less than 500 feet apart. Two horses and a single block and tackle were used, and the work progressed smoothly and rapidly. Among interested spectators were Assistant General Manager A. S. Brown, of the Western Union Company; Secretary W. J. Sefton, of the Subway Company; Superintendent J. Elliot Smith, of the New York Fire Department, and Mr. Hayward and Mr. Wiley, of the Standard Underground Cable Company.

Buffalo Electrical Society.—At the last meeting of the society, Mr. W. Finn spoke of the voltaic battery, in the second of his series of lectures on voltaic electricity. His interesting address included storage batteries and the obtaining of electricity directly from coal. At the next meeting of the society, Mr. Frank Kitton will lecture on the simultaneous transmission of telegraphic and telephonic currents over a single wire.

Electricity or Cables.—The directors of the Third avenue surface railroad having decided to do away with the use of horses on their line, they are now looking into the matter of electric motors. But the cable idea has not been given up, and a choice will be made between the traction system and the electric motors. Edward Lauterbach said to a *Times* reporter on Saturday last that there was a movement in favor of electricity. Several motors were satisfactory in many respects, and it is believed could be adopted on the road. If a storage system could be satisfactorily arranged, there would be no doubt of success. A rail for electric currents was undesirable, and the company certainly did not want a chance to exist of a horse stepping on a rail and being thrown several feet up into the air. He said that the cable system was still under consideration. When the directors had chosen a system, the work of fitting up the road would begin as soon as possible, probably in the spring.

Electric Welding.

BY PROF. ELIHU THOMSON.

The energy of the electrical current at any time at our disposal may be utilized to produce motion in its various forms, such as mass motion, as in electric motors, driving machinery, or propelling a train; wave motion, as in telephonic sounds; light or luminous wave motion, as in electric lamps; chemical decompositions, as in electro-plating; and heat motion, which latter nearly always attends the conversions just alluded to as a waste or loss, more or less unavoidable.

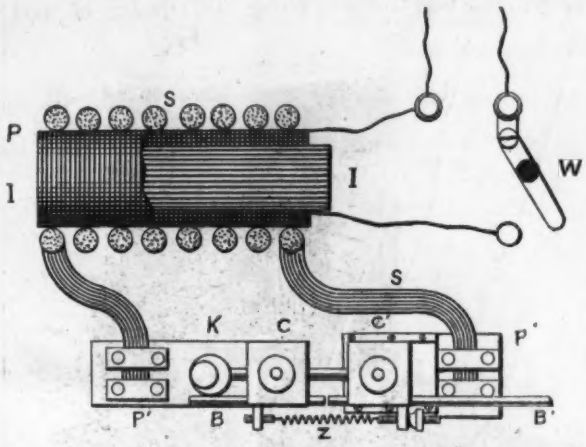


FIG. 2.—DIAGRAM SHOWING ARRANGEMENT OF COIL IN FIG. 1.

Whilst I do not share in the anticipations of some over sanguine people, that the energy of electricity will be used when directly converted into heat for warming our buildings, still we have ample evidence of the fact that for special purposes heat so produced can not only be applied practically but economically. Electric heating is perfectly applicable to cases in which the supply of needed heat is small and requires to be kept up for a prolonged period under perfect control, or in which a sudden, quick heating of moderate amount is to be used. Again, if the temperature required to effect a given operation is above that producible by combustion, electricity may be employed; for the temperature producible by its means is only limited by the vaporization and expansion of the materials heated. We find an instance in the Cowles electric furnace, used for the reduction of those metallic oxides which even in the presence of carbon will not at ordinary furnace temperatures part with their oxygen, but which, in the electric furnaces are subjected to temperatures very near that of the vaporization of carbon, or that of the fusion of the oxides and consequent intermingling of their particles intimately with those of carbon.

It is my purpose in the present paper to give an account of a new way of utilizing the heating effects of heavy electrical currents, for uniting or causing union between pieces of metal, whether of the same or of different kinds. I have called the process "Electric Welding."

Hitherto the metals which have been welded with facility by the ordinary methods of furnace heating and subsequent hammering have been wrought or soft iron, steel, platinum, pure gold, and a few others. So far as I know, cast iron, brass, gun metal and bronze, German silver, zinc, tin, lead, aluminium and other metals and alloys more or less commonly used, have not hitherto been welded, and even in the case of copper, which softens readily by heat, the welding together of two pieces, though not impracticable, has been so difficult as to have been seldom tried with success. Much less, indeed, has it been generally practicable to weld pieces of unlike metals together; and even with iron, very small pieces can scarcely be welded in the ordinary way on account of the rapidity with which the heat is dissipated, thus reducing the temperature below the welding heat.

All this, however, is changed when we come to the practice of electric welding. Some of the metals which it was before impossible to weld become those most easily dealt with. Such are cast iron, brass, bronze, zinc, tin, etc. Copper, formerly welded with so great difficulty and uncertainty, becomes remarkable for the facility with which joints are made when the proper temperature is reached. Iron, steel, platinum and like metals, formerly known as weldable, are united electrically with great ease and certainty. Thus far pieces of all the metals tried have welded to other pieces of the same metal. When, however, the pieces are of different metals or alloys, failure may result from too great differences, either in their temperatures of softening or in their specific electrical and heat conductivities.

The method of electric welding may be briefly stated to consist in forcibly pressing together the bars or other pieces to be joined or welded, and then passing an electric current of large volume through the pieces, a small portion of the bars on each side of the place of abutment serving as a path for the current. The resistance at the meeting point of the abutted bars gives rise to a welding heat at this point, and the pressure causes a thorough union, with generally an expansion at the union due to the approach of the pieces under pressure. The process is evidently a simple one.

Now let us inquire what are the results and the possible uses of electric welding? An enumeration of some of them may be of interest.

One of the most evident applications is in joining, end to end, wires of copper and iron for various purposes, such as in forming coils of magnets, and in telegraph, telephone and electric light line construction, thus avoiding the existence of clumsy and resisting joints.

In the factory of the Thomson-Houston Electric Company, wires have been so joined in the practical construction of dynamos, and the method will be extended in use there as soon as the necessary apparatus can be built.

I have specimen wires of copper and iron of varying sizes with electrically welded joints, some of which wires have been bent and twisted without rupturing the weld. There is no reason why very heavy bars may not be operated upon by using sufficiently large and powerful apparatus. The largest diameter of copper rod thus far welded

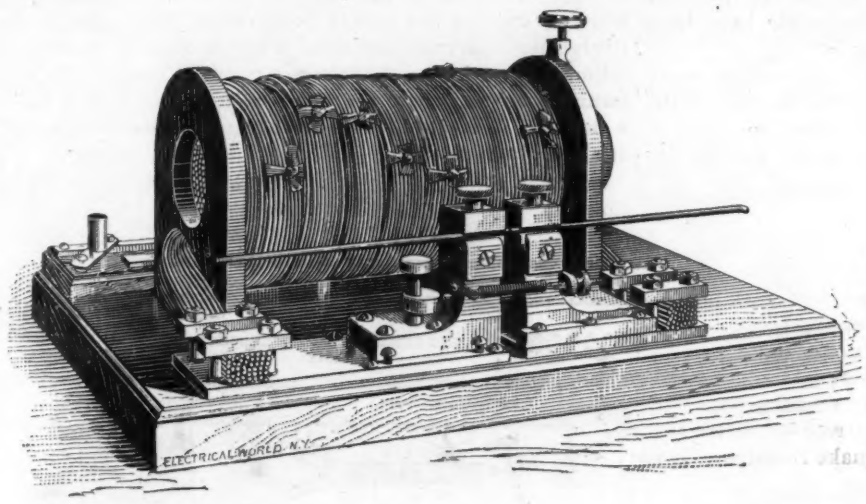


FIG. 1.

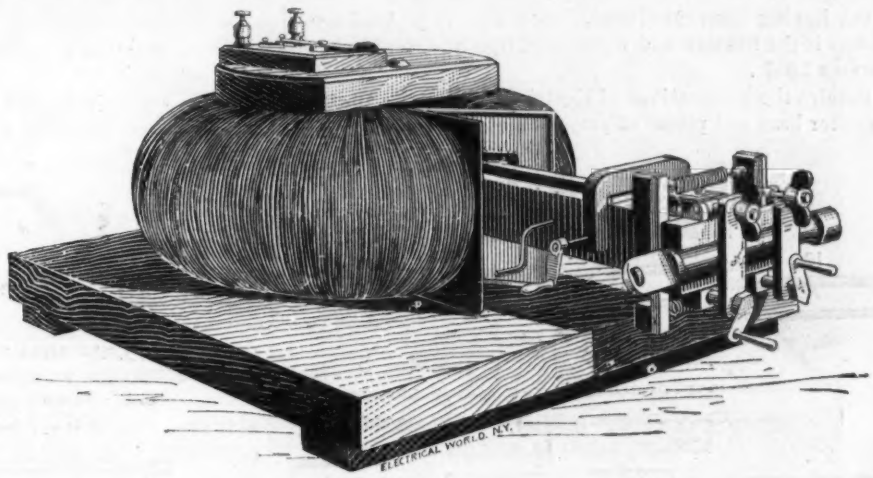


FIG. 3.

ELECTRIC WELDING: TWO FORMS OF INDUCTION COIL.

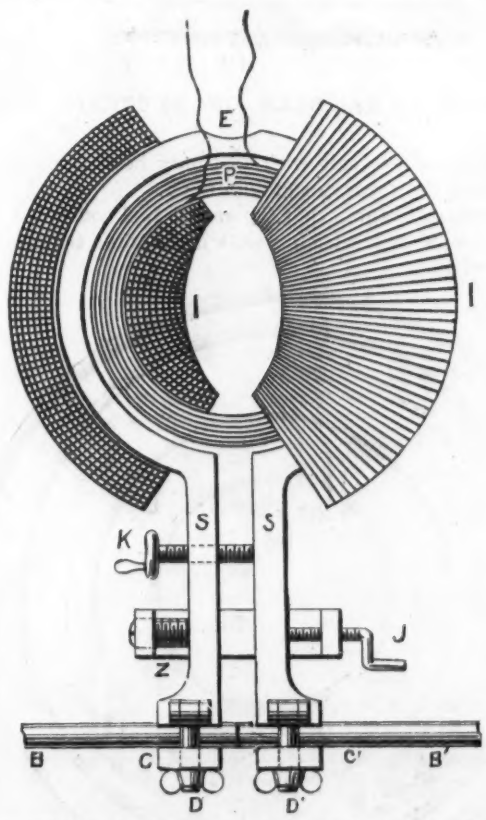


FIG. 4.—DIAGRAM SHOWING ARRANGEMENT OF COIL IN FIG. 3.

measures nearly $\frac{1}{16}$ inch, and of steel nearly $\frac{1}{8}$ inch in diameter (Fig. 6),* and so far as can be determined by estimation alone, this required a current of over 20,000 ampères. This is probably a much larger current than has heretofore been produced in any single conductor or machine. The difference between the sizes of iron and copper welded by equal currents is due to the smaller resistance of the copper and the greater facility with which it conducts heat away from the junction during the operation. The specimens which I have comprise a variety of sizes and shapes of iron, steel, copper and other bars, in some of which the expansion at the weld remains as formed, and in others it has been ground off or removed, to show the character of the metal at the weld.

Another obvious use of the new welding process is in the butt welding of metal tubes or pipes, examples of which are iron pipes of various diameters, brass and copper tubes joined end to end, and a lead pipe with two joints, which pipe has, as a test of complete union, been much bent after the formation of the joints (see Fig. 8).‡ The joints on the iron pipes have in most cases been hammered during, or just after, the welding, and are very firm and strong. It is quite possible to make long lengths of cast-iron or wrought-iron pipe for street service, which may be laid with few calked, cemented or screw joints, or, even as a completely welded, unbroken pipe, bends being made at intervals to allow for expansion during change of temperature. For high pressures of steam, air, or gas, such a system would seem to be desirable. Long iron pipes are now very laboriously made from short lengths for bending into coils containing from 100 to 1,000 feet. The electric weld would render such an operation easy.

In making or repairing endless bands, such as band saws, wheel tires, barrel and tank hoops, the electric method promises to be of great utility, some specimens of such work having been produced. (See Fig. 7).† Analogous to this is the heating and welding of iron and steel links of various kinds.

Besides the applications of electric welding to uniting together bars and pieces of various metals, of various sections and of various shapes, as briefly outlined above, there is a very wide field of usefulness to be found in the manufacture and repair of tools and parts of machinery. In the factory of the Thomson-Houston Electric Company at Lynn, there are in use a number of tools having electric welds, and it is intended also to extend the welding to the construction of other tools to which it is applicable with a saving of cost.

As examples of such work (see Fig. 9)§ I may mention the lengthening of screw taps, drills, reamers, augers, to any amount required; mending chisels and punches when worn out or broken, by providing them with new edges welded to the old bodies; lengthening screw bolts by welding sections of bar between the screw and the head of the bolt, or shortening them by cutting out sections and reuniting the head and body; welding new drills and reamers to the taper shanks of old and worn out drills and reamers; renewing the points of worn-out centres for lathes; renewing the cutting ends of lathe turning tools when worn out or broken, instead of casting the steel aside as useless; uniting short pieces of shafting into longer lengths; reuniting the pieces of broken tools; and, in general, welding steel pieces to steel or wrought iron or even to cast iron bodies of tools. One quality of steel

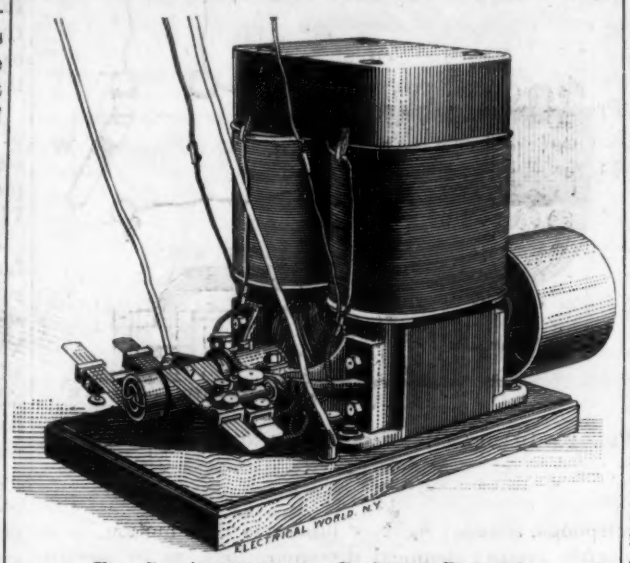


FIG. 5.—ALTERNATING CURRENT DYNAMO.

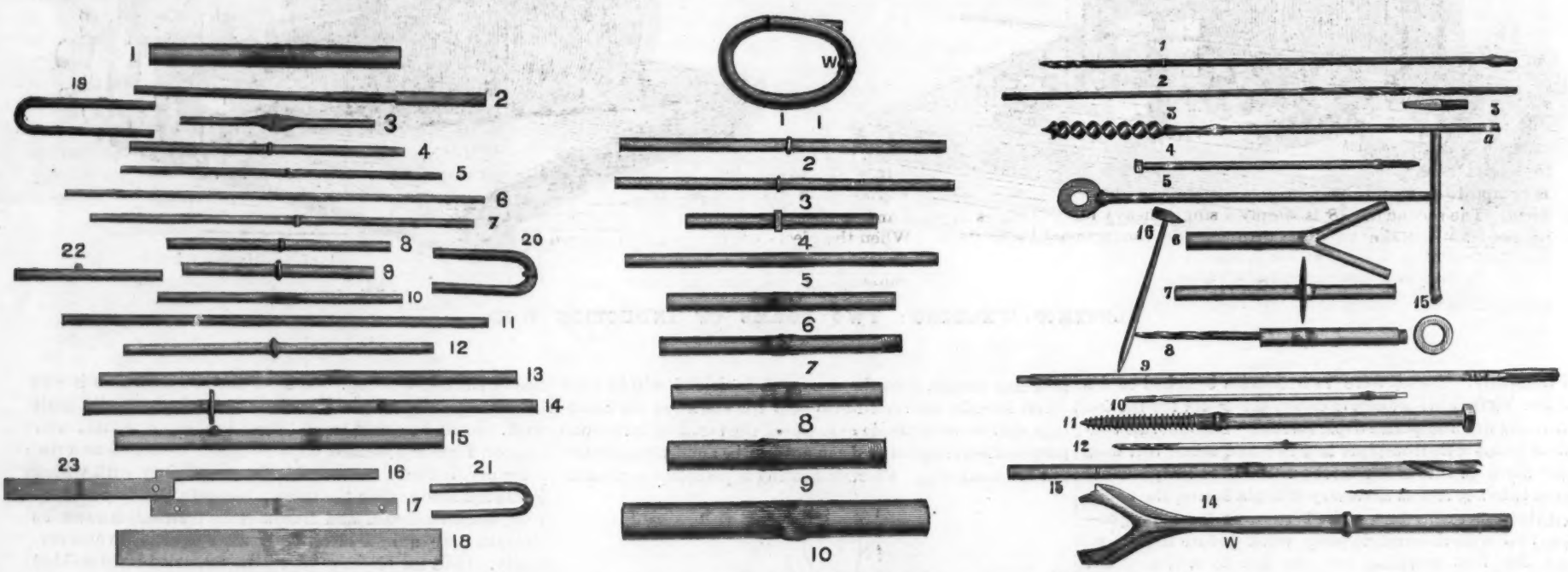
may be used for the cutting edges and another for the body of the tool. There are, without doubt, many instances in which the construction of tools used in the various trades may be cheapened by joining together pieces to form such tools as would otherwise have been cut or forged from one piece of metal.

Electric welding is applicable to the very delicate work of the jeweler's art, and equally so to the joining of the parts of heavy machinery. I have united the ends of wires less than $\frac{3}{100}$ths of an inch in diameter, and the size of the larger pieces dealt with has only been limited by the power of the apparatus at command.

I have reason to think that the actual fuel consumed in effecting a weld by electricity, notwithstanding the loss in boiler, engine and electrical apparatus used, is less than in the ordinary blacksmith's processes, and chiefly because of the very small time needed to effect the electric junction, as well as to the application of the heat to the metal locally at and near the weld, with the consequent small losses by radiation and conduction. Besides this, the time required is so short that quite a number of joints may be formed in the time ordinarily required to make one, and the pieces are not required to be skillfully manipulated during the process—a great advantage in the working of large pieces.

Having thus rapidly reviewed the possible applications, as they now present themselves, let us turn to the operation itself.

In the first place, electrical current energy is a product of its pressure or electromotive force by its amount of flow or volume. Hence, to represent a certain amount of energy, we can have a small volume of current with a high electromotive force or pressure, or a very large current with a very small electromotive force, just as we may have a small flow of water at a great head or pressure fed to a turbine, and yield, say, a horse-power, while the same power may equally be yielded by a much larger flow of water under a small pressure or head, with a suitable wheel. Or, electrically speaking, a flow of current of one ampère, with an E. M. F. of 746 volts, represents energy at the rate of one horse-power, or 33,000 foot-pounds per minute, and the same energy is represented by a flow of 746 ampères with one volt, or 1,492 ampères with $\frac{1}{2}$ volt. In arc lighting, ordinarily, a current of ten ampères and 2,500 volts E. M. F. is not infrequently used. In incandescent lighting in multiple arc, 250 ampères and 100 volts would represent an equal energy and in electric welding 50,000 ampères and half a volt would be the equivalent; and this would probably weld a bar of steel $1\frac{1}{2}$ inches in diameter, as nearly as I can now estimate the conditions. But there is quite a difference between running electric lights and welding. The lights demand the power continuously, while in welding the energy is demanded for a comparatively short time, varying from a few seconds to half a minute or more, according to the size of the piece. If my estimates are anywhere near correct, it would require to weld a bar of steel $1\frac{1}{2}$ inches in diameter, an expenditure of about thirty-five horse-power for less than a minute.



FIGS. 6, 8 AND 9.—SAMPLES OF ELECTRIC WELDING.

The apparatus used in generating and applying the currents for electric welding will vary according to the character of the work to be done. The chief essentials to be found in it are, outside of the source of current, (1) a means for getting the heavy currents into the pieces without too much waste, such means being solid conducting clamps bound upon each piece; (2) a means for forcing the pieces together during the passage of the current; and (3), a means for holding the pieces in the position desired. The conditions are usually fulfilled by arranging the heavy copper clamps or chucks in line with each other, but at a distance apart which can be adjusted, and arranging a spring and screw for forcing the pieces to-

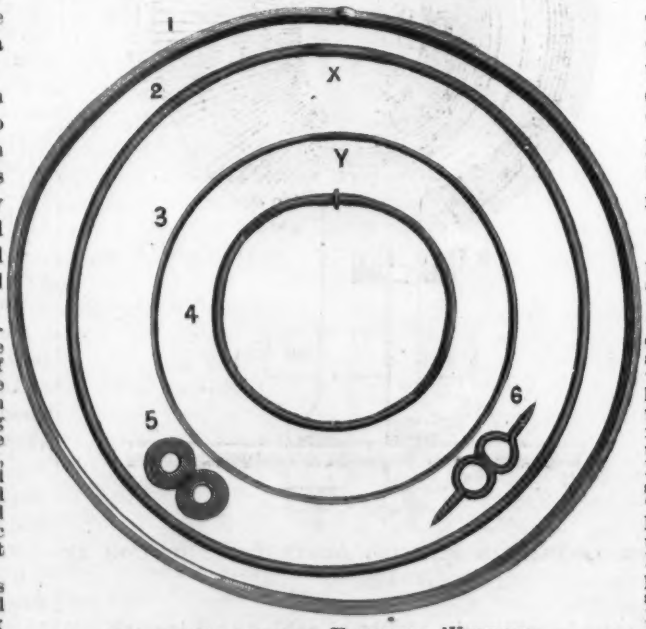


FIG. 7.—SAMPLES OF ELECTRIC WELDING.

*FIG. 6.—1. A ¾ in. steel bar welded in the middle. 2. Bar composed of copper, brass, and steel. 3. Copper bar in which the weld has been hammered out flat. 4, 5, 6, 7, 8. Copper bars of different sizes welded in the middle. 9. Lead bar welded in the middle. 10, 11, 12, 13, 14. Steel and iron bars with welds which have been more or less dressed off after welding. 15. Bar having two welds; the bar is composed of two pieces of cast iron and one of steel. 16. Square steel bar with the weld dressed off, and not, therefore, perceptible. 17. Rectangular brass bar with the weld in the middle. 18. Heavy rectangular wrought-iron bar welded in the middle. 19, 20, 21. Copper bars welded straight and afterwards bent at the welded portion. 22. Round battery zinc composed of two pieces welded together in the middle. 23. Flat bar of copper welded likewise.

†FIG. 7.—1. Rectangular wrought-iron ring welded. 2. Brass ring welded at *X*, and the weld finished afterwards. 3. Small cast-iron ring welded at *Y* and the weld finished. 4. Copper ring welded at *Z*. 5. Iron washers welded edgewise. 6. Two screw eyes welded at the rounded portion.

‡ FIG. 8.—1. Lead pipe welded at *W* and bent after welding. 2, 3, 4. Brass tubes welded in the middle. 5. Copper bar welded in the middle, and the weld dressed afterwards. 6, 7, 8, 9, 10. Pieces of iron pipe of varying sizes welded, as seen, in the middle. Some of the welds are partially dressed.

§ FIG. 9.—1. Gimlet bit elongated by the insertion of a section between the square end and the twist. 2. Bar composed of a straight steel rod welded to a portion resembling a twist drill, which twisted portion is composed of three pieces of twist drill, two of the welds being in the twist. 3. An auger which has been elongated by the insertion of a piece between its square taper end and the twisted portion, and which square end has been afterwards twisted off by force applied while the middle portion was held firmly in a vise, the break occurring about one-half inch above the weld at *A*, and after the bar had turned through two or three revolutions without breaking. 4. Lag screw lengthened out by the insertion of a bar between its square head and the screw. 5. Bar of iron welded to the edge of an iron washer. 6. Bar of steel welded to two smaller pieces, so as to form a fork. 7. Thin steel disc welded between two iron pieces which are in line; giving the effect of a disc strung upon an arbor. 8. Small twist drill welded to a taper centre of a lathe. 9, 10. Screw taps lengthened out by the insertion of a steel bar between the screw portion and the square end. 11. Lag screw lengthened out by a similar insertion. 12, 13. Twist drills lengthened out. In No. 12 there are three welds, two of which have been partially dressed off, while the middle one is left untouched as formed. In No. 13 the drill after welding was put in a lathe and a chip taken from the welded part so that it is impossible to find the weld. 14. Bar composed of a cast-iron fork welded to a cast-iron cylindrical piece and this again welded to a wrought iron bar. The joint between the cast-iron piece and the fork is at *W* and has been dressed off, while the other weld is untouched.

gether. The clamps are connected to the terminals of an electric current producer, such as a very coarse secondary coil of an induction apparatus, the primary of which is supplied with alternating currents from an alternating dynamo; or, a cell of secondary battery of very low resistance and low electromotive force may be substituted for the coil.

One form of the apparatus (shown in perspective and section in Figs. 1 and 2,) may be described as follows: It consists of an induction coil composed of a core *I I* of iron wire about twelve inches long and 2½ inches in diameter, around which has been wound a coil of primary wire *P* to be traversed by currents from an alternating current machine. The outside or secondary coil *S* is composed of sixty-four wires, No. 10 B. and S. gauge bound together and passing only eight times around the core. The ends of the secondary strand so formed are bolted down to copper plates *P P'*, upon which the clamps *C C'* for holding the pieces to be welded are mounted. These clamps are formed of comparatively heavy blocks of metal. One of the blocks or clamps *C'*, is arranged to slide upon its copper bed plate, and is guided so as to move in a straight line towards the other block, under the action of a spring *Z* which is adjustable. This permits the two pieces *B B'*, held in the clamps for joining, to remain in alignment during the welding, attended, as it is, by a slight movement of the free clamp towards the fixed clamp. A cam *K* is arranged to be turned so as to separate the clamp blocks by forcing back the movable block *C'*, and to hold it so during the placing of the pieces in the clamps.

The clamps themselves are simple pieces of metal arranged to be screwed up or down to permit removal of, or to grip, the pieces to be operated upon. The operation of placing the pieces in the clamps in this apparatus requires only a few seconds. This apparatus, as described, is especially adapted to joining small wires of copper, small steel pieces, band saws of small size, etc. The primary coil is put into circuit with an alternating current generator and, together with the iron core, may be inserted or removed from the axis of the secondary coil to a greater or less extent in order to adjust the current to the size of pieces operated upon. The current produced by induction in the secondary coil is of large volume and low electromotive force. The resistance of the secondary coil taken alone is approximately .00015 ohm.

In another apparatus used by me (shown in perspective and section in Figs. 3 and 4) the construction is different, and much larger work can be accomplished with it. The primary coil *P* is simply a large open ring about 12 inches in diameter, 2½ inches wide and ¼ inch or more thick, and is composed of many turns of insulated wire wound on a form. The secondary *SS* is simply a single heavy bar of copper bent to make only one turn outside the primary coil, and the terminals of the single heavy convolution are bent outward to a parallel position and provided with powerful screw clamps *CC'* at the ends for holding the pieces *BB'* to be abutted. The secondary has the form, therefore, of a large copper jewsharp, with the clamps at the ends of the straight and parallel portions. The clamps are made movable toward and from each other by having the copper bar thinned and broadened at the middle of its curved portion at *E*, and farthest from the clamps so as to give to the bar a certain degree of flexibility.

The clamps *CC'* are arranged to be drawn together, when needed, by a powerful screw *J* and spring *z*, so that the desired pressure for forming the weld may be given; and another screw *K* is provided for forcing the ends bearing the clamps apart, when the pieces are to be inserted in the clamp preparatory to the passage of the current.

Both the primary coil and the secondary bar are wound over with a great mass of iron wire which passes through the open axis of the coils and over the outside of them, thus forming an endless iron core to both the primary and secondary conductors. These conductors are virtually enclosed in a tube or sheath of iron wire. The iron wire *I I* is in reality wound upon a sheet iron casing or guide, which keeps the wire from bearing upon the secondary bar and interfering with the free movement of the parts of the secondary bar itself, as well as of the clamps. The calculated resistance of the secondary bar is about .00003 ohm, and under a very energetic primary current it should be capable of generating more than two volts of electromotive force, but it is generally used with much less than maximum excitation. The alternating currents passed through the primary coil, produce, of course, rapid reversals of magnetic polarization in the iron sheath surrounding the copper conductors, and there results a transfer of energy by induction to the circuit of the secondary, such transfer being attended with a small percentage of loss. A current of a little over 20 ampères and 600 volts average in the primary may produce in the secondary nearly 1 volt and 12,000 ampères.

For furnishing the alternating currents needed I have designed and constructed a cheap self-exciting alternating current machine (shown in Fig. 5), one size of which machine, weighing only 500 lbs., can absorb a maximum of over twenty-five horse-power at 1,800 revolutions per minute, returning a fair percentage of the power as current for use in welding. The machine has only 10 pounds of wire on its armature and about 40 pounds of wire on the field magnets. The large output given by this small machine is rendered possible because the machine is called upon to furnish current at intervals only, as during the formation of a joint, and because at other times it runs without load.

Provision must be made by suitable switches to cut off the current from the pieces which are being welded when the weld is seen to be complete. This can be done, of course, by breaking the secondary circuit itself at the proper moment, but it is evident that for such heavy currents the switch would have to be very massive. Equally good results are, however, obtained by cutting off the primary current or by breaking the circuit of the dynamo, or by the shunting or cutting off of current from the field magnets. It is also desirable to provide a means for regulating the power of the currents so as not to suddenly overheat the pieces, especially where they are small or easily fusible. This can be done by inserting a variable resistance in the circuit of the primary, or by inserting into the same circuit a coil of wire with a movable iron wire core, the positions of which will govern the force of the primary currents. Another good plan is to vary the power of the field magnets of the alternating current machine in any of the various ways known for accomplishing such result.

To effect an electric weld, the pieces are rubbed bright near the ends to be joined, so as to insure a good electrical contact with the clamps by which the pieces are held, the pieces being firmly bound therein with their ends abutted in the space existing between the clamps, so as to leave a small portion of the bar projecting free of the clamps to the meeting point.

The ends abutted are, of course, kept clean to form good contact, and a little powdered borax is applied as a flux, usually after the pieces have been abutted; or, if the metal be of low melting point, as tin or lead, a little zinc chloride, rosin or tallow is applied.

When the pieces are of the same metal and of the same size or section, the junction is made by placing the ends of the pieces abutted midway between the clamps before applying the pressure to force them together and the current to weld them. But when they are of different metals or of different sections, the abutment or meeting point is placed nearer the clamp carrying the most resisting metal; or, the piece of smaller section, or the metal most readily fused, as the case may be, is so placed so as to project least, for the purpose of favoring the accumulation of heat in the other piece.

In joining pieces of different diameters the end of the large piece is reduced to the size of the smaller before attempting to effect the weld. It is, of course, best to have the clamps formed to fit the pieces, especially when the pieces are of irregular outline, but for round or square bars, simple V-grooves in the clamps suffice to hold the pieces in place and to give the requisite electrical contact with them. When the pieces are in place and pressed together by the means provided, the current is turned on, and at once the ends of the bars heat where abutted, a slight yielding or approach of the pieces takes place, and, more quickly than the operation could be described in words, the work is done. Sometimes the joint is pressed or hammered to still further perfect and consolidate the weld. This can often be done while the pieces are in place in the clamps, and while the heat is maintained by the current.

Whether the electric current has any peculiar action in assisting the welding I do not know, but I am inclined to think that, in some cases, it has some such influence, although much the larger effect is the simple result of heat and pressure. One circumstance, however, arising out of the electrical properties of the metals subjected to the action, may be noticed. This is the tendency exhibited toward a uniform heating of the section of the abutted bars, as a consequence of the fact that cold metal is a better conductor than hot metal, and that, therefore, any cooler line of particles in the section at once becomes the path for increased current and is brought up in temperature to equality with the other portions.

I would call attention to the fact that in the economical application of electric welding, cheap water power can be utilized to furnish the energy necessary, and that by conveying the currents over lines it can be utilized at distances from the site of the water power.

It only remains for me, before closing the present paper, to mention the fact that I am preparing to have specimens of metals which have been welded electrically, subjected to tests of tensile strength, etc., to determine what proportionate strength exists at the welded portion of the bar. That the strength is great the rough tests of specimens leave no doubt, but it is desirable to have the exact data. In illustration of this point I would mention the case of a lag screw, which was shortened by cutting out a section and welding the square head and screw portion together again. The weld was far less perfect than usual, as was easily seen, little or no expansion at the weld having taken place. Nevertheless, in turning the resulting screw into a block of hard wood by a wrench applied to the head, it twisted off an inch or two below the weld and the fracture shows that the metal was sound and strong at the point of breaking, while the weld was, of course, unaffected.

Among the curious things noticed in the use of the apparatus is the loud sound or snap due to the extra current in the secondary when the pieces in the clamps are not permitted to move together as the metal softens, and a rupture of the secondary circuit occurs between the pieces This rupture, although occurring in a circuit whose length is a very few feet, is attended with a very loud snap, a bright flash and forcible ejection of hot particles of metal, as if a fulminate cap had been fired between the pieces. I have seen this action throw white hot pieces of fused steel as large as peas a distance of six feet, and this fact suggests the advisability of keeping the eyesight out of line with the discharge.

As curious instances of work accomplished I may mention broken twist drills mended in the twisted portion, one specimen showing two joints made in the twisted portion of a twist drill (Fig. 9). Another curiosity is a bar composed of steel, brass and copper pieces joined end to end. Penknives which have lost their blades by breakage close to the handle have had new pieces of steel, which have been subsequently ground into blades, welded to the stumps of the old blades, such stumps projecting scarcely an eighth of an inch from the handle, and the welding has been done without removing the stump from the tortoise shell or other handle. Several other penknives have been thus resuscitated, and I am pleased to say that in the only instance thus far in which a subsequent breakage of the blade has occurred, it gave way at a distance from the weld.

Iron wire rings have been made of many short pieces of wire, and afterwards violently twisted and bent so as to produce short "kinks" without parting, although the short bends included the welded portions. Long pieces of copper wire have been made of a number of short pieces, and afterwards twisted in like manner without yielding at the joints.

The accuracy of the work done depends upon the true alignment of the clamps for holding the pieces, or upon their true adjustment as to relative position, when the pieces are of irregular form. For irregular work, the clamps should be capable of being shifted into various relative positions, a condition not difficult to secure.

Executive Committee Meeting of the National Electric Light Association.

A call having been issued by Mr. A. J. DeCamp, chairman, the Executive Committee of the National Electric Light Association held a meeting at the Hotel Lafayette, Philadelphia, on Dec. 22. There were present, J. Frank Morrison, A. J. DeCamp, Eugene T. Lynch, Otto A. Moses, Clarence E. Stump, A. Steuart, George W. Boyer and T. McCoubray. It was decided to hold the next convention in Philadelphia on February 15. The headquarters will be at the Hotel Lafayette, and the business sessions will be held in a place to be hereafter selected. The indications already are that the attendance will be very large and that the meeting will be more than ordinarily pleasant and profitable.

Electric Street Cars.*

MR. J. MURRAY MITCHELL: Although I only came in at the last part of this meeting, I have been extremely interested and listened with great attention to everything that was said by Mr. Martin, and I only rose for the purpose of corroborating what he has said in relation to the Baltimore road and also to direct your attention, and I think perhaps also his, to the fact that in the comparison shown in his report between horse-power and electricity, that the comparison of $6.50 to $4 is not as advantageous to electricity as it should be, because the average speed which is accomplished there with electricity is eight miles an hour and the speed which they formerly had was only four miles an hour, which of course reduces the cost in comparison, so that the cost of electricity should be put at about $2 as against $6.50, instead of $4, as against $6.50. That, I know, has not been brought out by Mr. Robbins' report directly, but I think it worthy of attention. I should also like to state that as counsel for the Safety Electric Railway and Power Company, which operates under the Daft patents, I had the pleasure, some two months ago, of closing a contract in Pittsburgh for the equipment there of a railroad to be two and a half miles in length, where the grade is 14 per cent. going up one of these terrible Pittsburgh hills. We first thought of equipping it without any safety device and relying on the mere traction attained by electricity and the weight of the motor; but as there happened to be a curve with a fifty foot radius on the grade of some seven hundred feet to the mile at that point, and as this happened to be on an elevated structure, something like our elevated roads, and as the danger, if there should be any slip of any kind in going around that curve, would be very great and would result probably in great loss of life, we thought it better to adopt a system which Mr. Daft himself examined and approved of, using a species of cog rail, but doing away with the old form of cog. It answers the same purpose without having the disadvantages and expense of the old system. That road, I think, will be fully equipped by the latter part of March and probably be running by that time, or in the early part of the spring. We have, too, there the underground conduit, which is being constructed by Mr. Wharton, of Philadelphia. He took the sub-contract. He is a man who has built a great many of the cable roads. We have a very strong form of conduit, it being formed of slot rails seven inches in height and they are supported by ties and also by chairs which are made very heavy and almost strong enough to hold firmly the slot rails without any other support. This road also has the overhead system, making a combination of the two which has not been previously tried in this country; and I only hope that at the time that road does run I may have the good fortune to see a great many of you out there and have the pleasure of taking you out on the first ride.

MR. J. WETZLER: Mr. Martin has remarked in his paper that one of the principal points to be considered was the coal bill. It is interesting, therefore, to note that in the

* Discussion of paper read before the American Institute of Electrical Engineers, Dec. 7, 1886. Capt. O. E. Michaelis, U. S. A., in the chair.

Julien electric railway at Hamburg a calculation has recently been made on the basis of sixteen hundred kilometres run; that is equivalent to about one thousand miles. Mr. Huber, the engineer there, calculates that for the thousand miles run the energy required to propel the car one kilometre was, on the average, equal to three-fourths of a horse-power hour. Now, that figures out in this way: If it takes three-quarters of a horse-power an hour to propel a car one kilometre, and assuming that three pounds of coal per horse-power per hour is what a fair, average engine will do, then the energy or coal required to propel the car one mile would be three and a half pounds of coal per car mile. Now, take for instance, the Third avenue road in New York. On a basis of three and a half pounds of coal required to propel a car a mile, we should have, assuming there were three hundred cars—I think Mr. Martin puts it at 360—say, then, there are sixty extra cars, which are either summer cars, or cars laid off for repairs, that would give 175 pounds of coal per car per day. I am basing that figure on a run of fifty miles per car per day. That would give 52,500 pounds of coal a day, or twenty-six and a quarter tons. Calculating a ton at three dollars, we should have for the coal bill alone per day only $78.75, and that is with accumulators. I think the company would be very willing to spend $78 for coal, if that will do it. That is what it figures out at.

The Chairman then called upon M. Julien, who spoke in French, his remarks being translated by Mr. C. O. Mailloux.

M. Julien expressed his thanks and his great gratitude for the honor conferred upon him, and wished to say that as Mr. Martin had thoroughly covered the points in his paper, that it was scarcely necessary for him to elaborate them further. He said that the circumstances under which the tests were made at Antwerp were such that they represented almost an inimical feeling to the question of electrical traction by any process whatever. During the six months that the tests lasted every detail of the system was subjected to the closest scrutiny; the cells were sealed, and they were kept almost under lock and key, and he was scarcely allowed himself to look at them. The tests were made by judges, the most competent engineers and electricians, and were made with every precaution that might be necessary to prevent any tampering with the regular order of procedure. There was a feeling which was quite current in the general engineering circles that there was not much reliance to be placed upon electric traction, particularly by accumulators. Even electricians themselves were in such an infantile state of evolution that they thought it might be well enough to wait until they had grown a little farther; and as to accumulators it would be well enough not to think of them for some time. Referring to the statement made by Mr. Martin, and the assertion based on it made by Mr. Wetzler, that the expenditure of energy necessary for electrical traction is three fourths of a horse-power hour per kilometre, and that as the energy required for the lamps must also be counted in, which he certainly thought would be ten cents a day, he calculated that the total expense of about two dollars a day per car would be necessary for the energy actually needed, and that counting an expense of two additional dollars for all other costs of maintenance, wear and tear, interest and various other expenditures, that we would arrive at the cost of four dollars which had been mentioned. M. Julien said that the cost was thus found by the experiments made at Antwerp and that cost might be considered, so to speak, historical; that it might be conceded to be the cost on which they could safely calculate the probable expenditure of running the electrical car with accumulators, on heavy traffic. M. Julien also mentioned his desire to submit his system of electrical traction to the electricians of Paris—to a committee—and to exhibit it there and allow it be tested in order that the figures and statements as to its value might be corroborated, and the facts as they had been found at Antwerp be known more generally. He stated that there, also, he found a great deal of opposition; that the French electricians had been, systematically almost, preaching against and slandering the accumulator. At any rate, a jury comprising some of the most able electricians was selected. M. Julien's endeavor was to place himself under exactly identical conditions with the system of electrical traction that was exhibited by the firm of Siemens at the electrical exhibition of 1881, and to make a comparison with that on the score of cost, facility of running and various other conditions; and that although the jury comprised men of conservative inclination and disposition like MM. Fontaine, Hospitalier and other men very well known themselves in connection with the application of electric motors, and although M. Fontaine himself took charge of the accumulators and discharged them himself, and did not let M. Julien have anything to do with the manipulation; yet, M. Julien said, he had received a dispatch that very morning stating that they had conceded every point that he had made with them, and that they had found the figures as to cost which he had given them, as being the figures representing the cost at Antwerp, had not even been reached; that the actual estimates of cost of running under the conditions at Paris were much more favorable than those arrived at in Antwerp. He had received two diplomas of honor, one for the car and one for the system of accumulators.

Mr. C. J. Van Depoele: I can simply corroborate what has been said. Still there is one little plant that I might give the exact cost of, because the cost is about the main thing to be considered. We ran a plant in Minneapolis, Minn. This is, I believe, the largest electric railroad ever run in this country, or anywhere else, so far as I know. We have there about a sixty horse-power motor, and the train consists very often of ninety tons weight, or ninety-one tons. We have run it for about nine months. I might state also that they have tried a soda motor there, which I will tell about later. But at all events we have been running there at about an expense of three thousand pounds of coal a day—that is, starting to work at six o'clock and running till half-past eleven at night. Certainly, any of the locomotives that used to do the work before consumed as much as four tons of coal a day for the same work, which shows that although we have to transform our power twice, still we will have a great economy over the ordinary steam engine. Our system is not now running for the simple reason that some other parties persuaded the authorities there that they were going to bring there for them to use something wonderful in the shape of a soda motor—a soda fountain with a stick in it, or something of that kind. The soda motors came and we went off the track and let them on. But let me say those soda motors can hardly pull themselves and at present are lying there like a lot of old scrap iron in the shops of the railroad. Of course the authorities there would not at the present time like to take back the electric motors for fear of stultifying themselves. But we ran very practically over that route, using only very common apparatus. The whole thing was only a common freight car with four ordinary thirty-six inch wheels and an ordinary gearing from the motor to the countershaft and from the countershaft to the axle of the wheels and to the axles of the common car, wearing out only one belt in all that time and working eighteen hours a day, carrying forty-seven of their regular railroad trains a day. So it was shown that electricity can be used for heavy work as well as for light work.

Another instance in which figures might be given—of course all this figuring will come much easier after we have big plants running—is this: We are now putting up a big plant in Montgomery, Ala., where we have twelve cars running, and when all is finished we will be able to give the exact cost of running; but so far as we have tried it, and the grades are six and a half and eight per cent. there—in fact, there is not a foot of level ground in Montgomery—with two cars we have consumed an average of nineteen hundred pounds of coal a day, so that it costs but five and a half or six dollars a day with the two cars with the engineers' wages. This is a very small plant, and if small plants can do as well as that, larger plants can do much better.

Mr. C. O. Mailloux: Mr. Chairman, I am interested in electric railway matters just as I am in other branches of electrical engineering such as once in a while come under the province of an expert and have to be investigated. At the same time, while I am watching its development, I like to look at things from a practical point of view. There is a question which is now agitating the minds of practical engineers, and which gives me the opportunity to ask Mr. Van Depoele a question. It is this: There is a great deal of doubt, a great deal of difference of opinion, as to the manner in which the energy shall be applied to the shaft of the motive wheel—the driving wheels. I heard Mr. Van Depoele say that he gears his motor to a countershaft and that he conveys the motive power from that countershaft to the driving wheel by means of a link belt. Now that link belt is, I understand some to say, one of the bugbears of the electric railway, and I would like to ask Mr. Van Depoele about the length of time that that link belt has been running; also about how great a velocity it will stand safely. That is to say, how many feet per minute will it run without making too much noise or without being strained unduly; and, also, how long the link belt will last under those conditions?

Mr. Van Depoele: I will be very glad to answer this question. We have some link belts running now for the last eight or nine months on street cars. We have tried several different modes of transmission to gear directly to the axle of the car, something which will obviate the vibrations transmitted by the axles running directly over the road. Tnere at once we have a flexible connection between the motor and the car. The motor can stand on the same body of the car itself and consequently does not participate in the heavy vibration to which it would be subjected if it were carried directly by the axles of the wheels. Consequently, with street cars that is about the best connection I can find at present. I would have it understood, however, that any ordinary link belting in the market will not answer the purpose. We have a link belt which we had made for the purpose of our business. We have tried the cast iron link belt, and found it to make considerable noise, and to wear out too fast, while it is not capable of running at a high speed. I have run at thirty miles an hour, and I did not myself formerly believe that a link belt could do the work, but it seems that when it is solid and correctly made you can run it at that speed without hurting it. The link belt used by us consists of two side pieces of steel pressed, and the steel bushing pieces are then fastened to a steel thimble at the upper end. Right through that steel thimble goes a pin, which catches the two lower ends of the next link, and consequently there is no friction in the small parts, it being confined to the larger surface of the thimble, right over which there is a steel roller. There is really no wear to the chain. We have had in Windsor, Canada, a chain running there for about eight months, and, in fact, it is just as good to-day as when first put down. The belt was then running at about the rate, I should judge, of one-third less than what the wheels were, or fully twenty miles an hour; and at the end of the track I stopped to feel whether the belt was hot, and it was not warm at all. Of course, for heavy work and fast speed, I think the link belt would not be suitable. Then you want to have a direct mode of connecting. Certainly it is very difficult to get a good connection between the motor and the axles of the wheels, because to make a motor large enough to connect directly with the axles of the wheels without any gearing, the motor has to be made too large. I think it would be out of the question to so construct it for ordinary speeds. But to gear back, of course, you have to use some kind of gearing. Friction gear I do not take much stock in. It is not reliable; it wears out, and there is always some trouble about it. Of course the cog-gear is positive, but it makes too much noise. But if you put up gear that is solid and mathematically true and with good lubrication I find there is not much noise when the gear is entirely covered up. We have the same gear in Scranton, which cannot be heard when running. It is well boxed and works well, and does not wear out and fits tightly; although, how long it will last, of course, we do not know. We have several of them running and they run well. If you gear back in the ratio of one to eight you will have a good deal of noise; at one to four you will hardly have any noise at all; at one to eight there will be considerable wear; at one to ten, of course, still more. There is a kind of medium between those and you will have to take your choice in making your proportions; but the link belt, I believe, is the best thing for street cars to day; that is, a belt made specially for the purpose.

Mr. G. W. Mansfield: I certainly would strengthen Mr. Van Depoele's remark that it is amost difficult and exceedingly troublesome thing to find any good method of connection between the motor and the driving wheels. He has spoken of a variety of methods of doing it, and there are other varieties yet of which he has not spoken. But one thing which he said, viz., that the link belt gave a flexible connection between the motor and the driving shaft, is an excellent plan, and, in fact, it would be necessary where you needed a flexible connection. But I would like to bring up just this one point, and that is, that we have before us two distinct fields to labor in. One field is to equip the 20,000 cars already in this country, running over some three or four thousand miles of track and being drawn by some 125,000 horses, and with the system of construction which now prevails; and the street-railroad men, of all men, I believe, are hunting not only for a means of propelling their cars, but they are also hunting for a better means and better mode of constructing their railroads. Now, with the present variety of construction of a large majority of the street railroads of this country you would need your flexible connection and possibly leather belts, perhaps the link belts; or possibly a good combination of gear can be arrived at to get this flexible connection. But the other field is the field of new construction, and this field is the one in which, I think, the electricians should specially labor. They should start now, and not wait five or ten years, but should educate the railroad profession and the street railroad men and the street railroad builders—the street car-builders, rather—convincing them that their cars and that the street railroads must be built for electric motors. And if then they are built for the electric motors, we can supply them with something which is perfection, which will entirely do away with a great many evils which exist with horses and with every other means of drawing and propelling the cars, even with the cable. The cable has a limited field; it cannot operate branches successfully, and it has a variey of other evils which I will not speak of now. But with the electric methods in the construction of new roads, due to the marvelous flexibility of electrical application, there is no known or conceivable difficulty that electric motors and the application of electricity cannot successfully eradicate and overcome. So, then, I would merely give expression to this simple, modest thought, which the electric railroad men and the profession engaged in that work should impress upon the minds of all street railroad men, and all men interested in street railroads, viz., that their roads in future must be constructed from the very start for the application of electric motors, no matter by what system, but by the application of electricity. Then, I think, and by that means only, will we come to the general and successful application of the motors to every railroad throughout the country.

Mr. Mailloux: There are two points which I wish to dwell upon in what Mr. Mansfield said. I would begin by the last, although it may not be proper. He speaks of the correct method—evolutionary method of the electric railroad—as being that in which the electrician anticipates all that now hinders him and warps him in the development of his problem, by beginning from the very first, from the outset, to prepare the road for electricity, all its appurtenances and everything else. That is a conclusion that has already been arrived at in reference to electric lighting. You will find that in the new buildings, the latest large houses, factories, etc., we do not need longer to go to the laborious process of drawing wires through or taking them up to the ceiling; but we anticipate them by preparing for any system of electric lighting and put in wires inside of the ceiling instead of having to run them outside. There is here an exact anology to the remarks of Mr. Mansfield. I was very much pleased to hear Mr. Mansfield speak. I wished that he had permitted himself to go more fully over some of the fine morsels and choice bits with which he could treat us from his stock of experience. He has been intimately engaged in the study of electric railroading for at least four years past and I do not think that there is anybody here who is better posted in regard to the intricate details and complications of the problem than he; and I have heard him particularly speak of that very question of transmitting power from the motor shaft to the driving shaft, and he made some very pertinent remarks in another meeting before another society on that subject, and I think it would be conducive to the general information of us all if he would briefly review what he said then. I have reference particularly to the methods he spoke of in connection with round belting, etc.

Mr. Mansfield: It was at the meeting of the Electrical Section of the Americal Institute, that I gave an illustration, by means of diagrams, of the different kinds of methods which had been used, as far as I was familiar with them; I can only now repeat, if you desire, just those methods which I presented then, but I do not wish to discuss the efficacy of any single one of them. I said then that the most primal and the most perfect method obviously would be the application of the armature to the driving shaft direct. That does away with every particle of gearing. That method has been utilized by Mr. Daft in regard to a certain system more especially, and that is the Enos elevated system. The motor locomotive has two driving wheels and the armature shafts extend on each side of the driving wheels, the armatures being keyed directly on the shafts, and, of course, the periphery of the driving wheel is small. It is figured for a certain speed, twelve to fifteen miles an hour. The main difficulty which, I think, exists in using this direct gearing is simply a constructional one, on the electrical basis. The ordinary horse car wheel, if I remember rightly, goes only some ten or a dozen revolutions a minute to accomplish the ordinary speed which is used upon the tramways. Now, then, to construct a motor or an armature to go at that slow rate of revolution and develop any power, you would have to go to just the extreme which Mr. Van Depoele mentions and thus construct a *pretty* large motor. If you go into the electrical portion of it, you will see that you have got to get a certain length of wire upon your armature to get counter electromotive force and to do that at such a low rate of speed you have to construct a *rather* large machine, I think. Now, then, there is, next, a simple pinion upon the armature shaft, which runs in a large gear and is keyed upon the driving shaft. That method is simple, but it has its objections, although, if the mechanical details are properly carried out and well proportioned even up to as high a ratio as eight to one or ten to one, I think that a very successful application can be made, and that is the application used on the Baltimore road. Worm gear can be used which is equally as simple as a pinion within a gear; it is equally as simple, but it is not as economical. The action of a worm in a gear is, we have always been told, a very brilliant method of losing power; that as high as thirty, forty, fifty, and even sixty per cent. of power is lost, due to the friction of the worm within the gear, although Mr. Reckenzaun, I believe, states that he has constructed a worm of a very high pitch and has constructed his gear to match, and he gets a very low loss, 15 or 20 per cent., if I remember rightly, running in oil. Now, then, we go from that more simple process to another one, which is introducing one more subject, and that is, introducing a countershaft. Now we can drive dynamos by a train of gears. We can drive from a pinion

upon the armature shafts to a gear upon the countershaft and then again from a small gear out of that upon a driving axle. Of course, any little difficulties which were apparent in the previous case would be increased in this case by the introduction of another gear. The noise could be cut down by using leather belting, and a variety of leather belts, round, flat, angular and link belts. An innumerable number of forms of leather belting can be used which would take the rapid revolutions of the armature shaft and carry them to the countershaft with very little loss and with not much noise, and then the slower running countershaft with a pinion upon that, running the slow gear or slow driving axle, can then be employed very easily and with scarcely any noise and with very little wear. The flexibility, then, of this system would be between the armature shaft and the countershaft.

Now, there can be a different modification of this, even, and I noticed in THE ELECTRICAL WORLD a description of one used by an inventor out West in which he used a train of gears very similar to all the gears that are on the lathe in the ordinary machine shops. That is Professor Henry's method, I believe. Now, that is the perfection of complication, and I do not know as I can go any further than to mention it in just this brief outline of the various ways which I am familiar with, that have been in practical operation. There is one other which I perhaps should mention in regard to a direct running with no intermediate gearing. I ought to have mentioned it first; it is that brought out by Mr. Stephen D. Field lately, and consists in using a crank shaft on the end of an armature shaft which is attached to a connecting rod. That certainly does away with all intermediate gearing, and if he can successfully cut down the speed of the revolutions of his armatures to apply it to a street car, with all the street car difficulties of going so exceedingly slow as to keep pace with a mule that has two tons behind him and a very cross-grained disposition in front, and you have got to go just behind him and cannot go before him—if he can cut it down to that slow rate of speed, of course, for tramways, there could not be anything much better. But for lighter suburban roads, where you have got the right of way, and where you want to run at a rapid rate of speed, of course, then the direct application is superb.

Mr. S. D. FIELD: As to Mr. Mansfield's remarks, there are two ways to obtain the equivalent of speed of armature necessary. One is to confine yourself to the ordinary two-pole machine, using an excessive number of armature turns; the other is to increase the number of poles of the machine. This I have accomplished and with only two brushes. Then, again, with regard to the conduits for city traffic, I propose, in introducing a street railroad on a line already established, to take out the sleeper bodily and put in its place a hollow cast iron girder, the top of which is capped with a steel rail with a flange carried underneath, giving a slot with a sharp angle to the street surface, so that you cannot get a horse's heel calk into it, but you can have your carrier in there. Mr. Martin said that this was the only way to carry very high potentials. I propose to carry 1,000 volts or more, but at the same time have the minimum strain on the insulators; that is, the insulating medium. To accomplish that I establish a power station at either end of the line, have two conductors insulated, and carry a zinc potential in one conductor and a copper potential in the other. Now, every car on such a line has exactly the same potential wherever it may be. By that means I can carry as high as a thousand volts on the line with great ease, and you have got to have this high electromotive force with a large number of cars and reasonably sized conductors. There is no other way to do it that I can see. Then for very large motors I wish to call your attention to a little improvement. You know how the things will spark unreasonably. I find that the spark is not governed by anything particularly. It seems to vary with the load, and with the machine, and with the man that works it. I thought I would let the spark govern itself. I have put a couple of brushes on the commutator at points of nominally equal potential on either side and connected them with an auxiliary motor called the brush governor. As long as these brushes are at the proper point no current will pass into them. But let them get ever so little out and immediately the current commences to go through the auxiliary motor, which turns the brush holder to position of neutrality. The result has been very satisfactory.*

Mr. J. M. PENDLETON: Mr. Martin in his paper took the occasion of saying that those who spoke well of the accumulator had been looked upon as knaves and fools. As the accumulator and its uses have formed the main subject of my investigations in electricity, I felt that, although I have been thoroughly consistent for the last five years in the matter, we had now arrived at a time when we could boldly face electricians and the public with the service and the good service that the accumulator was capable of. It is now some two years since its value in connection with electric traction came to my attention. I have appreciated and understood the remarks of our distinguished guest, M. Julien, to-night, one of the gentlemen whose name was thoroughly familiar to me as the associate of M. Camille A. Faure and whose intelligent work in the development and the application of the accumulator to railway traction was appreciated by us before his arrival in the country. The remarks made to-night will go far to instruct the railroad men of America in the fact which we have known long since, that the electric motor is the engine best adapted for their purpose.

Mr. MAILLOUX: I would like to suggest to Mr. Pendleton that he might tell us something about his system in connection with accumulators, which he has brought forward and which seem to possess some features of merit, namely, the combined conduit and accumulator system.

Mr. PENDLETON: The system which Mr. Mailloux has referred to is a combination of a conduit with an accumulator system for energizing the motor. On nearly all of the systems of electric railways there will be a necessity for distribution of passengers at the different termini, and it occurred to me some time ago to study up the matter, and devise a way of refreshing the accumulator during service and in the direct transmission of energy from the station to the car. There is always the question of insulation and loss by resistance which has formed a very difficult problem, in many instances, to solve, as we know, by the different railways which have been established in Europe. But by combining the two systems we get extra convenience and elasticity. Current is taken directly from the dynamo where it is the most economical, and over the parts of the line where resistance comes severely into play, the accumulator would afford a means of propelling the car, as at the termini.

Mr. PENDLTON then described the system in detail as given in THE ELECTRICAL WORLD.

Mr. STILES, of the Van Depoele Company, in reply to inquiries stated that his company was running something like thirty miles of track daily and about 28 cars. "The road that we have been running at Minneapolis is being run by steam cars. The cars were ordinary cars the same as steam cars. We put it in as a temporary affair to enable the company to run their cars until they could get some ordinance to allow them to run by steam. However, they have offered to purchase the apparatus of us but they have had some misfortunes and especially in the soda motor line. They were trying to operate four soda motors made by the Baldwin Locomotive Works. The last time I was there, Mr. Hill, the engineer—there were four boilers built by the gentleman—called my attention to the coal on the floor—about two bushels. He said that was the last of thirty tons they had used to charge that one motor with, and they had not got it to run yet."

* For detailed description see THE ELECTRICAL WORLD, Nov. 6, 1886.

The Polychromotelepantophotophonograph.

BY W. J. C.

A long-haired scientific crank once lived on Russian Hill;
The march of science failed to march with his ambitious will—
And his very last invention, which increased his fame by half,
Was the Polychromotelepantophotophonograph!

This instrument so wonderful was fitted by degrees
With a sounding-board, a diaphragm, and many rows of keys,
Besides electric wires and complete harmonic staff—
As a Polychromotelepantophotophonograph!

The Professor called upon me, and in manner shrewd and keen
Explained the salient features of his intricate machine;
He seemed so much in earnest that I did not dare to laugh
At his Polychromotelepantophotophonograph!

A large array of instruments was here in one combined
In a mode more readily assumed than rigidly defined;
Hard it is to sift the golden grain of Science from the chaff,
Ev'n in Polychromotelepantophotophonograph!

While the tele did the "distance," and the photo gave the "light,"
The chromo added "coloring," and graph supplied the "write;"
Panto was the "universal"—there was nothing done by half—
On the Polychromotelepantophotophonograph!

Poly stood of course for "many," as in many languages
The subject matter traveled to its goal beyond the seas,
And, lastly, phono "sound" produced, when needed, in behalf
Of the Polychromotelepantophotophonograph!

We set to work next morning, then, to test the new machine,
Having first secured connection with the cable submarine,
And we studied Western Europe from the Tiber to the Taff,
Through the Polychromotelepantophotophongraph.

We read the very last quotations from the Paris Bourse,
We heard the infant King of Spain a-screaming at his nurse,
And next a weighty Reichstag speech by a portly Prussian Graf,
Via Polychromotelepantophotophonograph.

These several experiments went off without a hitch,
And appeared as colored pictures through the photo-chromo switch;
So then we got the whiskey out, and a rousing health did quaff
To the Polychromotelepantophotophonograph.

To a local lecture room we went, transmission to begin,
And polygraphed to Paris, Pesth, Pultowa and Pekin,
An eloquent description of an Aztec cenotaph
On the Polychromotelepantophotophonograph.

Within a dime museum we exposed the diaphragm
And photochromed to Smyrna and to Seringapatam
A vivid living likeness of the double-headed calf,
Per Polychromotelepantophotophonograph.

We judged the time had now arrived to put the crucial test,
So signaled London, Paris, Rome, Berlin and Bucharest.
We turned on all the switches and the full harmonic staff
On the Polychromotelepantophotophonograph.

We opened in the Sand lot on a Sunday afternoon,
While O'Donnell howled and ranted like a dissolute typhoon,
Intending there to focus him and his following of riff-raff
With the Polychromotelepantophotophonograph.

We had photochromed the lepers, with a dozen new effects,
And were running fifteen languages and eighty dialects,
When I felt a kind of earthquake—in another moment—Paff!!!
Went the Polychromotelepantophotophonograph!!!!!!

While I exposed the diaphragm, professor turned the crank
Till the labor made him thirsty, so he loosened his grip and drank
A draught of soda sour from his innocent caraffe,
Smashing Polychromotelepantophotophonograph!

The "Doctor's" flow of language strained the heated cogs too much
While simultaneously engaged on Russian and Low Dutch,
So the old Professor's soldiering a second and a half
Killed his Polychromotelepantophotophonograph!

When I helped the shattered scientist to get up from the ground
He presented an appearance that is very seldom found—
He was polychromed all over, like an erudite giraffe,
By his Polychromotelepantophotophonograph!

You ask me, gentle reader, what became of the machine?
I can answer you with certainty 'twill never more be seen;
The scientific outfit went a-kiting over Kaf*—
The Polychromotelepantophotophonograph!!!

—*San Francisco News Letter.*

* Kaf is the mythical impassable mountain, supposed by the ignorant of the Mussulmans to encircle the world; originally the Caucasus.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Dec. 20, 1886.

I find considerable interest among business men in the work of the long-distance telephone people. Mr. Leonard, the local manager for the American Telephone and Telegraph Company, tells me that the company has already quite a number of special subscribers in New York and Philadelphia, paying good rentals, and that ordinary New York telephone subscribers are highly appreciative of the fact that they can talk directly for five minutes with their Philadelphia correspondents for the small sum of $1. A good deal of solid business talk can be crowded into five minutes, and then the saving in time over mail or telegraph is something extraordinary. The Boston circuit is not ready yet, but when it is it will be an immense convenience.

The Sprague Electric Railway & Motor Company has paid its respects to the State Tax Department with the sum of about $1,100. The increased capitalization of the company is $1,000,000. It was formerly $100,000. If anybody has still any doubts left as to the future of the electric motor, he should see Mr. Sprague's detailed list of motors supplied and orders on hand. The machines are going out to every part of the country as fast as they can be made, and the comments of the users are more than enthusiastic. Why shouldn't they be? There is no neater, cleaner, simpler, cheaper machine to-day than a good electric motor.

The Empire City Electric Company, 779 Broadway, are actively engaged filling some very nice out of town orders for dynamo gas lighters, or "positive gas igniters," as they call them. A look into their store windows—provided you can squeeze your way to a front place—reveals a scene of great bustle and attractiveness. Several figure groups are in motion in one of the windows, to the great amusement of passers-by. The motive power is electricity, of course.

Mr. D. Chalmers is back in his old electrical home, representing the firm of E. S. Greeley & Co., 5 and 7 Dey street. Mr. Chalmers has a good field with this big and busy concern, for all his energies.

I understand that no electrical supply stock is complete unless it includes Shaw & Geary's electric vibrating gas burners, and I have reason to believe the truth of the report, seeing how good these burners are.

The Excelsior Electric Apparatus Company, 30 Maiden Lane, claim to have the only reliable pocket battery with scarf pin attachment. The price has been greatly reduced. This battery is useful also for testing and experiment.

Mr. A. T. Smith, 6 West Fourteenth street, has invented lately a new lava burner for multiple gas lighting. It meets with the approval of the trade, and is in demand. It is made in imitation of porcelain, and works well. His lava tips are enjoying a good sale. Since his removal to new quarters in the same building, he has made and brought out several improvements and novelties. His electric weather vane, for example, gives indications at any point of the direction of the wind. Mr. Smith's construction department is also on the increase, and he is busy fitting out various places with complete electrical equipment.

Mr. Benjamin Blum (formerly with J. H. Bunnell & Co.) and Mr. Benjamin Sturges have formed a partnership, and under the firm name of Sturges & Blum are now prepared to do all kinds of electrical business. They make a specialty of putting in electric bells, burglar alarms, etc. They are located at 150 Broadway and 73 Liberty street. Benjamins have generally been favorites from Biblical times down, and as both these gentlemen are "pushing young particles," they will be heard from.

Mr. C. Baxter, 40 Fulton street, Brooklyn, is taking orders "right along" for his new "Star" bell. It is easy of adjustment and dustproof, and sells at a low price. Mr. Baxter is busy also on his push buttons, batteries, etc., and on his temperature regulator and automatic fire door closer, working in connection with his very sensitive thermostat.

The Hecla Electric Light Company, 26½ East 42 street, have just put in one of Hawthorne & Carr's Shipman engines, and are lighting their offices with their own system, in such wise as to make a good display of the special features of their dynamo.

The United States Electrical Company, 529 Fulton street, Brooklyn, have been giving the Bartholdi gas burner a special trial, and express themselves as very favorably impressed. They prefer it most decidedly.

The Metropolitan Telephone and Telegraph Company of this city is now very busy on the erection of its building at Nos. 16, 18 and 20 Cortlandt street, nearly opposite the building of the Delaware & Hudson Canal Company. It is a ten-story structure, which is to be ready for occupancy early next summer, and if possible by the first of May. For several years the old quarters of the Telephone Company, at Greenwich and Liberty streets, have, as your readers know, been very cramped, and no additional room sufficient for the business could be obtained there. The new building, which is now up to the fifth story, covers a lot 80 feet in frontage and 100 feet in depth. The plans are by Mr. Eidlitz, the well-known architect. The design of the front is quiet, but rich, the sole material used, with the exception of a few small columns of Scotch granite, being a red sandstone of very warm color and of excellent effect. The main entrance, a wide, low arch, is at the middle of the building. There are to be two elevators, and, of course, the structure is to be fire-proof throughout, heated by steam and lighted by electricity. The first four floors will be rented as offices, while the upper floors will be reserved for the exclusive uses of the Metropolitan Telephone Company, who will have something worth talking about in the way of switch-boards and concentration of apparatus.

The Standard Underground Cable Company have completed about one-third of the new work for the New York Fire Department, under contract for 200,000 feet. This cable is being laid east from the new Fire Department headquarters building through 68th street to Avenue A, and west from headquarters through 68th street, Lexington Avenue and 65th street, and across Central Park through Transverse Road No. 1 to 8th avenue and 66th street. The number of cables varies along the line of route from 17 cables with 102 conductors to five cables with 30 conductors. The conduit used is a plain pine box, laid in a trench two feet six inches in depth. After the cables are laid, the unoccupied space in the box is filled with melted pitch, the box-cover

nailed on and the trench refilled. This mode of operation possesses the merits of simplicity and cheapness, and permits extremely rapid work with the most thorough protection to the cables.

The cables used in this work are six conductor anti-induction Waring cables of No. 14 B. and S. gauge. Mr. Wiley reports the Standard Company as working day and night to keep up with the demand.

The Galvano-Faradic Manufacturing Company, 300 Fourth avenue, are offering a very fine faradic current medical battery for a very small sum, including sponge discs, pole cords, and holders. All parts of the battery are nickel and finely finished. The top is hard rubber, and the contacts are permanent. The box is of the best walnut, polished, and the whole can easily be carried in the hand without spilling the fluid. W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Boston, Dec. 20, 1886.

Mr. W. J. Jenks, manager of the municipal department of the Edison Electric Light Company, is spending a few days in this city.

A. Shuman & Co., a large clothing concern in this city, have erected a staff in front of their store having a globe or "time ball" for giving time at exact high noon. The apparatus has electrical connection with the observatory at Harvard University.

Mr. John E. Hudson, for some months past the general manager of the American Bell Telephone Company, has been elected also vice-president to succeed Mr. Charles P. Bowditch.

Mr. R. M. Kimball, for several years the general manager of the Electrical Development & Manufacturing Company, of this city, has tendered his resignation, which will take effect Jan. 1, 1887.

The Wainwright Manufacturing Company, of Boston and New York, are building a very large feed water heater for the Wilmington City Electric Light Company, of Wilmington, Del. The Wainwright heater is evidently finding favor among electric light people.

The Wheeler Reflector Company, of this city, has just received a large contract from the U. S Government for furnishing shades and reflectors for incandescent electric lamps in several of the public buildings in Cincinnati.

An authentic report comes from Fitchburg, Mass., that a new industry has been established in that city under the name of the "Fitchburg Manufacturing Company." One of the company's specialties will be the installation and equipping of small electric light plants.

Messrs. H. C. Williams & Company have purchased the plant and good will of the Taylor Manufacturing Company, New Britain, Conn. Electric call bells and other electrical specialties will be manufactured.

Messrs. W. L. Faxon, John C. Randall and C. A. Faxon, of Quincy, Mass., have filed with the Secretary of State a petition to the Legislature for incorporation. Their purpose is to build a street railway in Quincy to be operated by electricity or a motive power other than steam.

Mr. Dwight Slate, manufacturer of drills and special machinery, at Hartford, Conn., has recently purchased the plant of the Ballou Manufacturing Company. He will hereafter give much of his time to the making of all sizes of the celebrated "Ballou" lathe.

In the 13th annual report of the Board of Fire Commissioners of Boston (just issued) for the year ending April 30, 1886, there is a table (No. 5) giving "the different causes of fires;" and it is a noticeable fact—that while "27 were due to gas, and 74 to kerosene lamps and stoves," only "4" were attributed "to electric wires."

The new electric signal device which is about to be given a trial on the Arlington branch of the Boston & Lowell Railroad is simply the Union Switch and Signal Company's rail circuit system, with the difference, that instead of having a target beside the track for the engineer to look at, a bell is rung inside of the cab. This is accomplished in a simple, complete and unerring manner.

Mr. C. F. Hutchinson, late manager Baltimore & Ohio Telegraph Company's principal office in Boston, and Mr. Wm. M. Fisher—connected with the Commercial Cable Company—recently formed a co-partnership for the purpose of carrying on business in New England (with offices in Boston) as contractors and builders of telegraph lines.

Messrs. Blodgett Brothers & Company, of Boston, are manufacturing a large number of annunciators for hotels, clubs, residences and elevators. The style and quality of the work turned out of the factory of this well-known firm is always of a very high order.

A recent visit to the factory of the Smith Electrical Company, Attleboro, Mass., verified the report that I heard some time ago, relative to the attractive line of electrical goods made by Messrs. Swift & Smith, the predecessors of the present concern. One of the novelties which most engrossed my attention was the nickel-plated gas-lighting key. Formerly wooden buttons or keys were used, which were found to get out of order; and there is now substituted a material that will neither shrink nor swell, and that adds to the beauty of the goods.

This is an unusually busy season with the Billings & Spencer Company, manufacturers of drop forgings and general machinists' supplies at Hartford, and some overtime work may have to be done to get out goods for orders already in hand. At that place there is being made, among other things, a lot of engine forgings for the Westinghouse engines, which will require for their production forty tons of metal. Chemically pure copper commutator bars for electric generators are now being turned out in one solid piece, instead of being, as heretofore, made in two pieces and joined by soldering. Orders for supplies for electric machinery are now with this concern from three large electrical companies.

The New Haven (Conn.) Electric Light Company started up its incandescent lights of the Thomson-Houston system on Monday evening, Dec. 13, with 600 lamps in circuit. The company is said to be in a most satisfactory and prosperous condition, and both its arc and incandescent systems are spoken of highly by the citizens of New Haven. At present the capacity of the plant is about 450 arc lights, together with the incandescents referred to in the foregoing.

The Secretary of State has filed the petition, for presentation to the Massachusetts Legislature, of Thomas J. Mayhall, of Reading, that, on forming a railroad corporation under the general law, authority may be granted to him to build an elevated railway between Jamaica Plain and Boston Common, to be operated by cable, electricity, pneumatic tube or steam; of John W. Candler, Roland Worthington, M. D. Ross and others for incorporation as the Boston Elevated Railroad Company, with power to build, maintain and operate an elevated railroad from some point at Franklin Park to some point at or near Post Office Square, Park Square or Scollay Square, all in the city of Boston.

The *Manufacturers' Gazette* (Boston) says: The activity of those interested in the elevated railroad projects in and about this city indicates that the incoming legislature will be asked to facilitate the inauguration of these enterprises. This possible competition may induce our horse railway companies to exhibit a higher regard for the welfare and convenience of their patrons, and perhaps to stimulate the introduction of the cable system, or the use of electricity as a motor for propelling street cars. There is room for improvement over present systems.

The Boston Consolidated Street Railway petitions for authority to construct, maintain and use railways in Brookline, Cambridge, Somerville and Chelsea. In conversation with a reporter, President Powers said in relation to this petition that it meant simply an extension of the company's charter by the Legislature, and that before any further move could be made it would be necessary to petition, in the regular way, the city governments of the three cities interested. The charter now gave the company power to operate lines in Boston, part of Brookline, Malden, Medford and Everett. It desired privileges which had been readily granted to other companies. It wanted an extension of the privilege in Brookline, an opportunity to extend into Cambridge and build a depot there, and to lease or build in Somerville and Chelsea. No definite plan had as yet been formed, and, as had already been said, if the Legislature should act favorably on the petition it would then be necessary to go to the several cities and get their permission to do what the company should desire. Mr. Powers gave expression to the opinion that at no distant date electric motors were destined to take the place of horses.

The Citizens' Electric Light Company, of East Boston, is now lighting the Spalding Cable Works (on the wharf of the Atlantic Works) with nine of the Bernstein Company's "Jumbo" lamps, and also the factory of Thomas Strahan & Company, Chelsea, Mass., with the Bernstein 32 candle-power lamps. The Citizens' Company added a 25-light American machine this fall, and is now nearly filled up to its full capacity—125 arc lights.

W. I. B.

Springfield, Mass., Dec. 18, 1886.

The local *Homestead*, in its issue of Saturday, Dec. 4, had the following pleasing and merited remarks concerning a faithful officer and estimable gentleman: "Mr. John J. Moore, manager of the Springfield Electric Light Works, was tendered in September last a position with the Thomson-Houston Company of Boston, which he accepted, and submitted his resignation at the time. It took effect Dec. 1, and his going was the occasion for a very pleasant surprise, Tuesday evening, when the employés gave him a handsome hammered-silver tea service, worth $75. Mr. Bowen, the Assistant Manager, voiced the feelings of the men in a neat presentation speech, and Mrs. H. S. Hyde gave a fine set of table linen as a fit accompaniment. Mr. Moore first entered the service of the company as book-keeper in 1881, and in 1883 was given the management of the plant. It is no injustice to say that when he took hold the company had been losing money, the lights were unsatisfactory, and business men who tried them were ordering them out. Mr. Moore was given the fullest liberty in management, and he is proud to see that to-day the plant and service stand among the first in New England, and the Thomson-Houston Company send to this city business men who wish to see their system in perfect working. An unsolicited letter from Mr. Brophy, the chief inspector for the New England Insurance Exchange, says, after acknowledging that he came here prejudiced against the company's efficiency by outside reports, 'Your lights burn with unusual steadiness and the dynamos show unusual care and attention. I am very much pleased and think the company ought to be.' Mr. Brophy went over all the lines personally, and adds other praise in detail. It is Mr. Moore's successful efforts in this work that win him his new position, wherein he will look after the Thomson-Houston Company's interests at various points. * * * * The Springfield Company, by the way, is doing quite well, and its original capacity of 50 lights is increased to a system of 250 arc lights and 400 incandescents, with 20 horse-power in motors." Mr. Jerome Hyde, who succeeds Mr. Moore, is spoken of highly by the people of Springfield, and is said to be thoroughly posted in the work he has undertaken.

PENNSYLVANIA NOTES.

Altoona, Pa., Dec. 12, 1886.

The Altoona Electric Light Company started on Dec. 6 with 1,500 Edison lights in circuit. The building is of brick, 55 feet long by 40 feet wide, finely finished and fully equipped with the latest improved machinery. Three boilers in the rear, each of 100 horse-power, and built by the Taylor Manufacturing Company, of Chambersburg, Pa., are constructed after the most approved pattern. The engine room contains three automatic high-speed engines, two of 120 horse-power and one of 90, all built by the Taylor Company. They daily give evidence of the good work this company is able to turn out. I am glad to see this company entering in the field of competition for furnishing close-regulating engines, and wish them success. Unquestionably they are good engines in every sense of the word. Six dynamos capable of furnishing 3,400 lights are belted direct. So pleased are the people of this town with the light that new customers are enrolled daily.

Though this plant is not among the largest ones installed by the Marr company, it makes up in quality what it lacks in quantity. Every detail has been so carefully carried out that, as in every other plant which this well-known construction company has put up, satisfaction prevails. Their connection with a station seems to be a guarantee of first-class work. Their electrician, Thomas Spencer, spared no pains to place the apparatus in the best way, both as regards convenience and beauty. He has introduced several new features in the arrangement of the electrical appliances. A company may well feel proud of securing the services of such a man. The much talked of accidents have not occurred, and the gas company has each day more meters on its hands. P. C. F.

PHILADELPHIA NOTES.

Philadelphia, Dec. 20, 1886.

The electricians and manufacturers of electrical supplies of all kinds are remarkably busy at this season, as they have been for months past; and are looking forward to the most successful season they have ever enjoyed. Business is, of course, rapidly expanding; every day brings some new developments. The demand for electric lighting can only properly be spoken of in the superlative.

About three months ago the Schuyler Electric Light Company became financially involved by the sudden departure of the President for Canada. Since then they have been working out some kind of plan by which they could resume operations. This has been a pretty tedious task, because it involves so many interests, but the plan is so nearly completed that they expect to begin the new year with a new company and a large working cash surplus. In the meantime the corps of electricians have been busily engaged in perfecting improvements in the way of automatic regulators and the use of incandescent lamps on arc circuits. The Philadelphia agency has been quite busy putting in plant. Its recent installations, being all arc light plants, are as follows: One at Cape May, N. J., 50 lights; one at Millville, N. J., 100 lights; one at Belvidere, N. J., 75 lights; one at Bay Ridge, Md., for the Baltimore & Ohio Railroad Company, of 30 lights; and in Philadelphia, one at Croft & Allen's, of 30 lights, and one for the Mason Fruit Jar Company, of 30 lights. The Philadelphia agency is at 55 South Third street, under the management of Mr. Stephen Holbrook.

The Cleverly Electrical Works, at 1018 Chestnut street, are, it is well known, especially engaged on electrical appliances for gas lighting, being connected with and manufacturing all the work for the Pinkham Electric Gas Lighting Company. This concern has lately fitted up several fine residences. The Cleverly Works are also the agents for the "Little Giant" battery, for which they claim economy, endurance, high electromotive force, low internal resistance and the perfection of convenience, in telephone service, electric gas lighting, electric clocks, electric bell and annunciator work.

The Cornish Electric Bell Company, of 1111 Chestnut street, are agents for the Western Electric Company. They have fitted up a number of large buildings in this city, among which might be mentioned Wanamaker's Grand Depot, the Girard House, the Aldine, the West End Hotel and various others too numerous to mention.

The Partz Electric Battery Company continues to make a specialty of batteries for distinct purposes. Their portable battery is safe for rough transportation. Their cabinet battery for administering shocks, etc., can be used, it is said, for two years with but slight decrease of power; and when finally exhausted can be easily restored by renewing the exciting solution. Their acid gravity battery has proven very successful for small electric motors, incandescent lights, cautery, electro-plating, laboratory work, etc. Their open circuit battery is well spoken of for annunciators, telephones, bells, gas lighting appliances. Their improved copper gravity battery is highly recommended for light work requiring a constant current.

The Electro Dynamic Company, 212 to 224 Carter street, are the manufacturers of the Edco system of electric lighting both direct from the dynamo and also in connection with the storage batteries of the New York Electrical Accumulator Company. These accumulators are similar to those used by the Electric Power Storage Company of London, Eng., and the same as those used in Vienna, Berlin, and other large cities on the Continent. You recently illustrated one form. The company also manufacture the Griscom double induction motor for light work, larger motors for various purposes, automatic and Edco batteries, electric lamps, and general electrical work.

Dooner is showing his wisdom by doing away with the pneumatic system at his hotel and replacing it with electric bells.

The Knickerbocker Ice Company's new building, at Sixth and Arch streets, is fitted throughout with electric bells and appliances.

The Novelty Electric Company, of Fifth and Locust streets, are doing a very good business.

Partrick & Carter, of 114 South Second street, have a specialty in the "return" or "guest call" system. This is composed of an annunciator for office, as usual, but having a series of push buttons attached to same case and under the dial of the annunciator. These buttons correspond with the number of rooms. In case of fire, two or three of these buttons can be pressed at once, thus rapidly alarming the occupants of the rooms. They also combine a general fire alarm by which the bells in all the rooms of the house can be rung at once or separately by merely turning a handle or crank.

The Brush Electric Light Company, at their station 20th and Johnston streets, are running sixteen No. 8 Brush dynamos, ten of which are feeding sixty lights and the other six fifty lights each; two No. 7, one running thirty lights, and the other eighteen. The dynamos which are located on the second floor are run by a pair of 24x28 Corliss engines and eight Porter-Allen 8x16 engines. The plant is running very nearly full. The company have about 100 miles of aërial wires. The Cleveland Motor Company, 20th and Johnston streets, have had a very excellent demand for their motors.

This city has about 350 arc lamps in use now and will add about 135 next year. The number for next year is limited by the amount of money available for that purpose rather than by a reluctance on the part of the city to increase the number.

The Keystone Electric Light and Power Company have their station on Sansom street, above Seventh. Their plant consists of four steel boilers carrying 110 lbs. working pressure; three Westinghouse engines rated at 75 horse-power, with 80 lbs. of steam, but with the pressure they carry will develop 110 horse-power

each ; three Westinghouse dynamos with a capacity of 500 sixteen candle-power lights each, but they have carried as high as 580 to 600 lamps without any difficulty. The engines and dynamos are set at an angle with the walls of the station, and the dynamos fitted on compound slides on the foundations, so if one engine breaks down, by sliding the dynamo bodily 16 inches, it is brought in line with the second belt wheel of the adjacent engine, and, by running up the pressure in the boiler, one engine runs the two dynamos. They use no oil cans at all, the oil being kept in elevated tanks in the boiler room. It is brought down by a system of pipes to the dynamos, engines and cylinder lubricators. The oil is collected again in suitable pipes and carried back to the tanks. They couple all their dynamos together on the omnibus wires in the usual way, but their field circuits are coupled up so as to render it impossible either to reverse the machines or to short-circuit them in case of a belt coming off while two machines were coupled together. They use the Standard Underground Cable Company's cable entirely, and have no less than sixty-six cables leaving their station. These cables are calculated for and are laid out to get rid of feeder regulation altogether. These dynamos are so self-regulating that they run from one to 500 lights without any other change than less than a ¼ in. movement of the brushes. They have run day and night, stopping only a few hours on Sunday for three months. They run lamps of all power from 10 to 150 candle-power. This is one of the electric companies in which the parties have abundant faith in their own apparatus, as the entire stock of the company was subscribed by the employés and members of the various Westinghouse interests.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Dec. 18, 1886.

The Fort Wayne Jenney Electric Light Company are furnishing the Armour Packing Company, at Kansas City, Mo., with a 60-light arc plant.

Gen. A. K. Stiles, of the Van Depoele Company, is home from the East.

Some recent orders of the Van Depoele Company are : 20 city lights for Sherman, Texas, and 60 commercial lights for the same place. The city pays a rental of four thousand dollars a year for the 20 city lights. The Sherman order was received through Captain J. H. Andrews, of Denison, Texas.

The Van Depoele Company is also furnishing a 20-light plant for the Russell Wheel and Foundry Company, of Detroit.

The Electric Storage, Light & Power Company at East St. Louis, Ill., has been incorporated with a capital stock of one million dollars. The incorporators are Sylvanus L. Trippe, Edwin S. Chester, James F. Ewing, James L. Huse, and Dennis F. Slattery.

In Minneapolis, Minn., Arthur S. Huey has commenced action against his partner in business, W. A. Sheldon. Mr. Huey's statement is to the effect that they entered into a partnership little more than a year ago under the name of the Municipal Electric Lighting & Construction Company, the plaintiff putting into the business as a beginning $1,000, while the defendant put in his contract for the Edison incandescent electric light, the exclusive sale of which he held. At the end of three years they were to dissolve partnership, each to take one-half of the proceeds. In the meantime, the plaintiff claims that Sheldon has appropriated large amounts of the partnership funds, and in order to conceal the same had falsified and refused to balance the books, of which he was in charge.

In his action Mr. Huey requests a dissolution of partnership and that the defendant may be enjoined from farther interfering with partnership interests.

Mr. Forée Bain, of 95 and 97 E. Indiana street, Chicago, finds his capacity taxed to the utmost in taking care of the work in his line which comes to him. Mr. Bain's business is already an assured success, and the prospects for the future are very flattering.

The Bennett Telephone & Electric Company, of Indianapolis, Ind., have no cause to complain for lack of orders, their only difficulty being to keep up with the demand for goods in their line. They make only the best of goods, and fully deserve the success which their business is achieving.

Col. S. G. Lynch, of 146 La Salle street, Chicago, furnishes me the following telephone stock quotations :

Bell of Mo.	$159@$161
Central Union	49@ 50
Chicago	375@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Iowa Union	16@ 19
Michigan	73@ 75
Rocky Mountain Bell	40@ 45
United	17@ 19
Wisconsin	104@ 106

W. A. K.

THE TELEGRAPH.

Quick Time.—On Dec. 19, the Canadian Pacific Railway, working in connection with the Commercial Cable, had a test of speed between New Westminster, B. C., and London. Messages were exchanged, it is said, in one minute.

The International Cable Company.—The proposed new ocean cable to be laid by the "International Cable Company," is an English scheme, and the bulk of its shares are in English hands. The cable will be made at Henley's works, North Woolwich. The cables of the new route will connect at the Azores. The friendly relations of the company with Mackay and Bennett give rise to suspicions that there is an ulterior object in connection with the enterprise.

Bucket Shop Business.—When stocks are active, it is estimated, upwards of 500,000 shares are bought and sold in the New York bucket shops as against 600,000 in the Stock Exchange. In dull times the sales in the bucket shops and in the consolidated board actually surpass in amount the sales on the Stock Exchange by 100,000 shares or more. The cream of this business is skimmed by the Public Grain and Stock Exchange, Limited, the largest bucket shop in the country and probably in the world. This institution with the imposing name is better known as the "Big 4 of Chicago." The concern rents half a dozen rooms on the sixth floor of No. 18 Broadway, and boasts of 123 branch agencies throughout the United States.

THE TELEPHONE.

Brussels and Paris will have complete telephone inter-communication by January 1.

A Pole Suit Discontinued.—The suit of the First Presbyterian Church, Brooklyn, against the New York & New Jersey Telephone Company, to stop the erection of a pole in front of the Church property, has been discontinued by mutual consent.

New Zealand.—According to figures received by Gen. C. H. Barney from Dr. C. Lemon, of New Zealand, that colony has 1,755 telephone subscribers. The capital invested by the government in exchanges is $185,000, and the annual receipts are $70,000. There are 81 private wires.

The Rochester Troubles.—A Citizens' Mutual Company has been formed at Rochester by the opponents of the Bell Company, which meantime shows no sign of withdrawing from its present position, as to the revised rates. The Citizens' Company has about $50,000 subscribed, and is looking into the merits of a new writing telegraph system and a new telephone.

The Southern Bell.—The Southern Bell Telephone Company, doing business in the Southern States, has declared a regular quarterly dividend of 1½ per cent., and an extra of 3½ per cent. for payment Jan. 3, to stock of Dec. 23. This year this company has paid 1½ per cent. regularly, and the same extra each quarter, making 3 per cent. quarterly and 12 per cent. for the year. It now enters upon what amounts to 5 per cent. quarterly payments.

Suicide by Telephone.—According to the *Figaro*, a young lady committed suicide at Brussels the other day under very extraordinary circumstances. Having heard of the unfaithfulness of her lover, she called him up at his place of business by telephone and asked him if it was true he was going to marry Mlle. ——? He replied that it was quite true. "Then good-bye forever," were the next words that reached his ears, followed by the report of a pistol. The poor girl had shot herself.

The Government Suit.—A special dispatch from Washington of Dec. 14 says : Government counsel are hard at work preparing the papers, which will be filed in Boston, in the suit against the Bell Telephone Company, within a few days. Some of the counsel will go over to Boston to formally institute the proceedings. Solicitor-General Jenks and ex-Senator Thurman will probably not go on until the argument is about to begin. Every effort will be made to expedite the case, so as to get it to the United States Supreme Court as soon as possible.

"Margin" by Telephone.—A Wall street broker declares that the night before the recent slump he dreamed of a panic, and that in his efforts to call up his customers for more margin through the telephone, that instrument could not stand the strain and actually flew to pieces. As a rule, Wall street men are very superstitious, and acting on the premonition of the dream the broker in question saved himself trouble on the occasion alluded to by calling up his customers early in the day on reaching his office before the Exchange opened. His customers accredit him with having received inside information, but he says he acted entirely on the hint or warning of his dream.

THE ELECTRIC LIGHT.

St. Albans, Vt., is to be given the electric light by W. T. Smith and associates.

The Biddeford, Me., plant, beginning with 100 arc lights, is put in by the American Company.

Franklin, Pa.—Messrs. F. W. Mitchell and D. C. Grant are interested in a plan to put in an electric light plant at Franklin, Pa.

In Agricultural Machine Works.—Messrs Whitely, Fassler & Kelly, of Springfield, O., have put a Brush arc plant in their immense works.

Chillicothe, O.—Mr. F. Juneman, of the Brush station, has secured additional city contracts and is putting in Brush apparatus to meet the demand.

The Dardanelles are now lighted by electricity, much to the satisfaction of the Turkish military authorities, who are going to extend the work around Constantinople.

The American Electric Construction Company, Limited, has been incorporated in this city by H. E. Irvine and others, with a capital stock of $20,000.

Steubenville, O.—The Electric Light and Power Company, of Steubenville, N. Y., has been incorporated by C. H. Steele and others, with a capital stock of $50,000.

In a Car Factory.—The Youngstown, O., Car Manufacturing Company have just put in a 20 light Brush machine, driven by a Buckeye. The plant is greatly liked.

The Armington & Sims Engine Co,, Providence, R. I., have decided to enlarge their engine establishment so as to be able to get out more work to fill their orders.

Sandusky, O.—The Sandusky Electric Light, Fuel Gas and Supply Company are increasing their Brush plant. They consider the light the steadiest they have seen.

Muncie, Ind.—Mr. James Boyce has put a Brush incandescent plant in his flax works, and has added to the central incandescent station a Brush 1,200 c. p. arc plant.

Elizabeth, N. J.—The Westinghouse Electric Light, Heat and Power Company, of Elizabeth, has been incorporated by H. W. Pope and others with a capital stock of $100,000.

La Fayette, Ind.—The La Fayette Brush Electric Light Company has recently put in two more Brush machines of 45 lights each—1,200 c. p.—and a new Buckeye engine.

Morristown, N. J.—The Morristown (N. J.) Electric Light, Heat and Power Company has been incorporated by the well-known electrical engineer, H. W. Pope, and others, with a capital stock of $50,000.

Washington, D. C.—The Jarvis Engineering Company Boston, have received an order to set five steel boilers, with the Jarvis patent boiler setting, for the United States Electric Light Company, Washington, D. C.

Railroad Shops Lit Up.—The Pittsburgh, Cincinnati & St. Louis Railroad Company are doing a large part of their work by electric light, having already put Brush arc plants in their shops at Dennison, O.; Columbus, O., and Indianapolis, Ind.

Portland, Me.—The business of the Consolidated Electric Light Company, of Portland, Me., is increasing very rapidly. An additional fifty-light American machine with lamps was shipped last week from New York, and General Manager Sawyer contemplates a further increase of arc and incandescent apparatus, as well as the introduction of a number of Sprague motors.

Springfield, Ill.—Mr. A. L. Ide, of A. L. Ide & Son, engine manufacturers, Springfield, Ill., and president of the local electric light company, using the American system, gave orders while in New York last week for two twenty-five lighters to be shipped at once to his company. He reports the business of the company in splendid condition, and its light as very popular.

The Hartford Light & Power Company are displaying an energy worthy of old Connecticut. Without having a thing in place at the time of the order, the company three days later furnished incandescent lighting from its plant to a large local fair. The plant already includes a 600-light Mather machine and two 60 h. p. Westinghouse engines. Orders for 1,200 incandescent lights have already been received, and those installed are giving great satisfaction. Among those interested are W. F. Henney, B. F. Simmons, D. Henney and P. H. Woodward. The offices are at present with the Hartford Steam Heating Company.

Pittsburgh, Pa.—Mr. Eugene Ingold, general manager of the Pittsburgh Electric Company, and a general agent of the American Electric Manufacturing Company, was in the city last week and reported business in good condition throughout his territory. Mr. Ingold says that the gas companies, so far as he has been able to visit them throughout Pennsylvania and Ohio, "are very much pleased with the prospects of business between the gas companies and the American Electric Manufacturing Company, nearly all of whom express a determination to put in American apparatus in connection with their gas plants during the coming year."

Officers of the American Company.—A change has just taken place in the executive management of the American Electric Manufacturing Company. Mr. H. E. Irvine, who has been so long associated with it as treasurer, has accepted the presidency of the American Electric Construction Company, which is organized for the purpose of building electric light plants throughout New York State, and Col. W. R. Steadman, treasurer and general manager of the Newport, R. I., Gas Company, said to be one of the ablest gas engineers in the country, has accepted the treasurership of the American Company in place of Mr. Irvine. Col. Steadman brings to the American Company not only his ability as an engineer and a first-class business man, but is looked upon as the representative of the gas interest in the American system of electric lighting.

In the Far West.—The Seattle, Wyo., *Intelligencer* says : The Edison Electric Light Company of this city have received 25 new arc lights. They are of the Thomson-Houston system, of 2,000 candle-power each. The company have demand for more of the lights than they can supply. Workmen are busy placing new lamps in position. The firm of Mitchell, Sparling & Co., electricians, are very busy at the present time. Mr. Sparling is superintending putting in the plant of the Edison incandescent lights at Spokane Falls, and Mr. S. Z. Mitchell is kept constantly on the move between points in the northwest where the Edison system is being introduced. Mr. Mitchell superintended the introduction of the system into Seattle, and is now arranging to put plants into Victoria, Portland, Tacoma, Olympia, Port Townsend and Steilacoom. The plant at the latter place will be one capable of supplying 250 16-candle power lamps, and will be for the use of the Hospital for the Insane. There is talk of the Edison lights being introduced into many of the Eastern Washington cities during the coming year."

APPLICATIONS OF POWER.

San Diego, Cal.—An electric railway on the Enos elevated system is proposed by Mr. D. G. Dexter.

Ann Arbor, Mich.—The Common Council has under consideration the project for establishing an electric street railway.

Minneapolis, Minn.—The City Council has passed an ordinance extending until November, 1889, the limit for the use of steam power on the road entering the city.

Columbia, Tenn.—The Columbia Street Railway Company has an exclusive right for 30 years to operate a road by horse or electric traction.

Bladensburg, Md.—A company has been formed to operate a road eleven miles long, between Washington and Bladensburg, by electricity.

Brooklyn, N. Y.—The Brooklyn & Coney Island Railroad Company is to extend its line, and will experiment with steam, electric, petroleum and soda motors.

Lenox, Mass.—Mr. Stephen D. Field will, it is stated, build an electric railway on his system, from Lenox to Glendale, at a cost of $150,000. Lenox is a great summer resort for well-to-do New Yorkers.

Against Animal Power.—The day of horse cars on our crowded streets is drawing to a close. This is the age of machinery, and passengers can be moved by much more economical, more efficient and cleaner agencies than animal power. In a short time they will be as much behind the age as stage coaches and town criers.—*Boston Herald.*

Vetoing a Railway Grant.—Mayor Grace sent to the Board of Aldermen, on December 15, a veto of the resolutions granting the city's consent to the construction of an electrical surface railroad, as proposed by the North and East River Railroad Company. In the resolutions it was specified that the road should be run under the Bentley-Knight electrical system. This, the Mayor says, precludes competition. He also says that, as the proposed road is to run more than 1,000 feet over the tracks of the Belt Line, and as the grant would be of use only to the company having an arange-

ment with that corporation, there could be no competition. He also suggests that the Aldermen should fix a minimum price at which franchises should be disposed of. The proposed road is to run on South, Fulton, West and other streets, and proposes to connect most of the East and North River ferries. It is thought that the franchise will yet be granted. There is great need of a line on Fulton street, and the electrical project meets with general favor.

PERSONAL.

Mr. M. W. Goodyear, of E. S. Greeley & Co., has been elected Worshipful Master of the U. S. Lodge 207, of Masons.

Mr. Frank Magee, of the Electrical Supply Company, has just returned from a successful business trip west and south. He reports business and the outlook as favorable.

M. Ed. Julien has been created a member of the French Legion of Honor, in recognition of his work in the field of electric railways. King Leopold, of Belgium, has also sent M. Julien a cablegram congratulating him upon his success at the Paris Exhibition, referred to in our last issue.

Mr. T. N. Vail.—A report is current in Boston that Mr. Vail resigns from the presidency of the Metropolitan Telephone Company, of New York, to enable him to give his undivided time and attention to the accumulator business, probably making Boston his headquarters again, with offices in either the Mason Building or in that occupied partly by the Bell Company.

Mr. W. B. Somerville.—The severe strain that Mr. W. B Somerville, the chief of the press bureau of the Western Union, has been under in the past few years in the telegraphic strike and other exciting events of such character has completely undermined his health, and for several months past he has been quite an invalid, attributing his trouble to malaria. He is, however, rapidly recovering his former strength and color, and congratulates himself on a complete restoration. He daily takes a journey on the Staten Island ferry to enjoy the benefit of the air, and contemplates a voyage to one of the seacoast Southern towns.

Mr. C. P. Bowditch.—It is learned from a source believed to be reliable that Mr. Charles P. Bowditch, vice-president of the American Bell Telephone Company, and also a director and active member of the Executive Committee, has resigned these offices on account of the demands of his private business. Mr. Bowditch is also a director in the New England Telephone & Telegraph Company, and is expected to sever his connection there also. Mr. Bowditch is held by some of the sub-companies chiefly responsible for the firm and uncompromising attitude of the parent company toward the subordinate organizations, and as other changes in the Bell board are rumored, some modification of the past policy of the Bell Company is hoped for.—*Boston Herald.*

MISCELLANEOUS NOTES.

An Italian Electrical Society is proposed, after the style of the International Society of Electricians of Paris.

The Empire Electric Manufacturing Company has been incorporated in Brooklyn, N. Y., by J. W. Fowler and others.

Erratum.—In one of our references last week to the bucket shops, the Commercial Telegram Company was spoken of as the Commercial Cable Company.

Electric Time.—The Electric Time Company, of Waterbury, Conn., has been formed with Geo. M. Chapman as Manager. It will use the Warner system. The offices are in the Scovell House block.

SPARKS AND FLASHES.

For Swelled Heads.—An English wigmaker has invented an electric hat, which he claims is a perfect cure for nervous headaches and neuralgia. The apparatus consists of a small battery placed inside the lining of an ordinary silk hat, with the flat terminals outside the lining, so that when the hat is put on a current of electricity passes between the terminals and diffuses itself all over the wearer's head.

BUSINESS NOTICES.

Office of Light-House Engineer, Third District, Tompkinsville, Staten Island, N. Y., Nov. 18, 1886.

Messrs. E. P. Hampson & Co., 36 Cortlandt Street, New York:

Gentlemen: It affords me great pleasure to send you this expression of the entire satisfaction given by the steam plant, consisting of one 50 h. p. Armington & Sims Automatic High Speed engine, one horizontal tubular boiler, together with heater, pump and other accessories, which was furnished and erected by you in October last under my direction as a representative of the Government for operating the electric light machinery at the Statue of Liberty, on Bedloe's Island, New York harbor.

To the energy and personal attention of Mr. W. F. Haring, of your firm, is due the establishment in complete and satisfactory working order of the entire steam plant within less than four weeks from the day of beginning work.

Very respectfully yours, John Millis,
First Lieut. of Engineers, U. S. Army.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver steel and iron wire, shafting tools, etc.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

December 21, 1886.

Telegraph.	Bid.	Asked.
Am. Dist.	.....	40
Am. Tel. & Cable	68	72
Cen. & So. Am.	75	100
*Com. Tel.	103	.....
*Gold & Stock	92½	97½
*Inter. Ocean Tel.	92	97
N. Y. Mutual	72	.....
Pac. & Atl.	45	55
*Postal T. & C.	30	35
South. & Atl.	65	75
W. U. Tel.	70	70⅛
W. U. Scrip.	62	.....
W. U. Bonds	.....	122
Mut. U. Bonds	83	85
Telephone.		
Am. Bell	193½	195
Am. Speaking	115	125
Erie	28	28½
*Hudson River	52½	60

Telephone.	Bid.	Asked.
Mexican	1⅝	1¾
*N. Y. & N. J.	90	95
N. Y. & Pa.	.....	.....
New England	43½	44½
*Southern Bell	110	130
Electric Light.		
*Am. Electric	40	.....
*Brush	.....	.....
*Brush Ill	.....	.....
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	130	140
*Edison Ill	89	95
*Edison Isolated	.....	.....
*United States	.....	.....
*U. S. Ill	93	100
Motor.		
*Daft	.....	.....
*Sprague	600	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

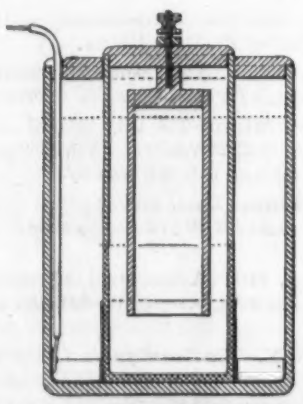
PATENTS DATED DEC. 7, 1886.

(1) 353,683 and (2) 353,684. Conductor for Mechanical Telephones; J. S. Jones, Brooklyn, N. Y. Applications (1) Feb. 20, 1886, (2) March 11, 1886. (1) A number of bare straight wires laid parallel to each other are surrounded by a sound-deadening cover of fibrous material. (2) Consists of a central wire of hard material, such as steel or iron, surrounded by a sound-deadening envelope of soft metal, such as lead.

353,694. Telephone Transmitter; J. W. McDonough, New York, N. Y. Application filed Aug. 28, 1885. The invention consists in combining with the electrodes of a telephone transmitter a magnet so arranged that variations in its influence shall tend to affect the position of the electrodes with relation to one another, the circuit of the coil of the magnet being under control of the transmitting instrument itself; it is operated in such a way that, coincidently with a movement of separation of the electrodes by a mechanical action of the transmitter, there shall be a change in the influence of the magnet, such that there shall be developed an increased counteracting influence opposing such separation, and the electrodes shall be immediately forced into contact.

353,715. Telegraph Transmitter; J. U. Shryock, Trinidad, Colo. Filed Feb. 15, 1886. The transmitter consists of a series of bars, contact springs, and contact openers and closers, there being one set of apparatus for each signal to be sent.

353,755. Telephone; M. F. Palmer, Jamaica, N. Y. Filed March 27, 1886. The invention consists in the combination of a telephone transmitter with a spring arm that carries a bar which is located between the diaphragm and the magnet, and which is provided with two springs carrying the electrodes.



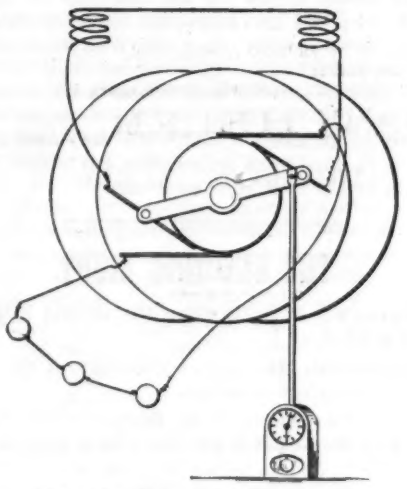
353,757. Voltaic Battery.

353,756. Automatic Fire Extinguishing Apparatus; A. Thompson, and R. O. Ritchie, London, England. Filed June 1, 1886. A thermostat closes the circuit which opens the valve of a sprinkler of novel form. The apparatus is arranged so that it can be tested and operated mechanically at will.

35,3757. Voltaic Battery; A. F. W. Partz, Philadelphia, Pa., Assignor to the Partz Electric Battery Company, same place. Application filed March 5, 1885. The invention consists in a porous clay cell, the lower part of which is to a proper height rendered impervious by being impregnated with paraffine, so that, when placed upon a metallic or carbon cathode at the bottom of a voltaic element it cannot be penetrated by the depolarizing liquid about its base, and that the anode inside of it be protected against wasteful action. (See illustration.)

353,783. Incandescent Electric Lamp; T. A. Edison, Menlo Park, N. J., Assignor to the Edison Electric Light Company of New York, N. Y. Application filed Nov. 9, 1882. The long carbon filament is provided with intermediate support for the coils to prevent their bending and touching. See illustration.

353,789. Railway Telegraph; E. B. Ives, New York, N. Y. Filed May 10, 1886. A system of telegraphing to moving trains in which the rail forms a part of the car or moving circuit.



353,986. Dynamo Regulator.

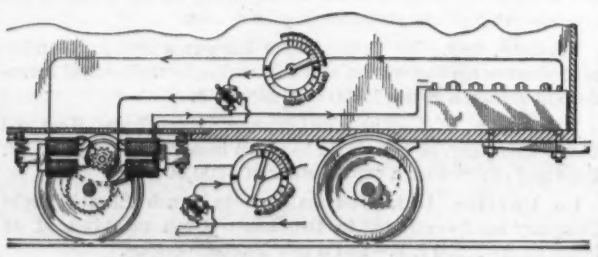
353,797. System of Lighting Cars by Electricity; J. H. Marshall, Grand Rapids, Mich. Filed April 13, 1885. The dynamo is driven by the axle of the car, and storage batteries are provided to maintain the current during stoppage.

353,827. Dynamo Electric Igniting Machine; H. J. Smith, Mount View, N. J. Filed May 18, 1886. Improvement on patent No. 201,296, March 12, 1878.

353,829. Electrical Propulsion of Vehicles; Frank J. Sprague, New York, N. Y. Application filed June 12, 1886. The object of the invention is to utilize the momentum of the vehicle in running on a down grade or in slowing down for the purpose of recharging the storage batteries. This is accomplished by increasing the counter electromotive force of the motor when on a down grade, whereby the machine becomes a generator giving current to the battery. (See illustration showing two positions of switch.)

353,840. Electric Clock for Transmitting Signals; John S. Bailey, Buckingham, Pa. Application filed Aug. 19, 1884. The apparatus shows novel means of closing circuits at definite intervals, and by means of which visual or sound signals are effected.

353,880. Electro-Magnetic Car Brake; H. S. Park, Henderson, Ky. Application filed April 19, 1886. The invention relates to car-brakes in which an electro-magnet is em-



353,829. Propulsion of Vehicles.

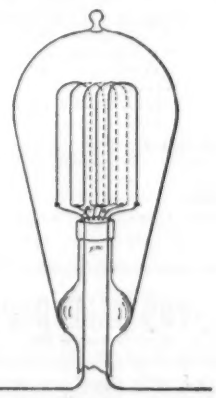
ployed for throwing in and out of gear connection between the brake-chain windlass and the car wheel.

353,915. Electrical Testing; C. S. Bradley, New York, N. Y., assignor to the Edison Electric Light Co., same place. Application filed April 5, 1884. The object of the invention is to discover the location of leaks on ground connections in multiple arc systems of electrical distribution. Improvement on patent No. 287,501.

353,940. Telephone Apparatus for Divers; H. V. Hayes, Cambridge, Mass. Application filed July 2, 1886. Consists of a novel method of combining a telephone with the divers' helmet, battery transmitter being employed.

353,984. Coupling for Electrical Conductors; Walter F. Smith, Philadelphia, Pa. Application filed Sept. 14, 1886. The coupling has an insulating covering, with openings for the passage of binding screws, and means are provided for filling in with paraffine or other insulating material.

(1) 353,986. Regulator for Dynamo Electric Machines; (2) 353,987. Electric Motor; (3) 353,988. Regulator for Dynamo Electric Machines; (4) 353,989. Annular Armature for Dynamo Electric Machines; (5) 353,990. Electric Regulator; E. A. Sperry, Chicago, Ill. (1) The invention consists in means by which additional lamps can be put in circuit at a given time, the clockwork being arranged to shift the brushes to the maximum commutator point at that time. It can also be used to reduce the number of lamps in circuit at a given time. Application filed March 14, 1883. See illustration. (2) The invention consists in the arrangement of circuits by which the counter electromotive force developed in the armature acts upon the field-magnets so as to augment their magnetism in almost the exact ratio that the energy in the armature is depreciated by the counter current, thus acting as a regulator. Application filed Oct. 13, 1883. (3) The invention consists of an arrangement by means of which (1) the strength of the current circulating in the field-magnets is varied by a counter electromotive force (2); of devices by means of which such counter electromotive force is varied in response to the



353,783. Incandescent Lamp.

variation of the main electric current; and (3) in an electrical device whereby the regulation of the field is made to depend upon the condition of the exterior useful circuit. Application filed Oct. 28, 1884. (4) The object of the invention is to secure lightness of weight with ample mass of metal, and the armature is of such a form that no extra poles will be produced in its core. Application filed June 9, 1883. (5) The invention relates to a hydraulic apparatus for regulating the strength of current produced by the machine. Application filed Nov. 1, 1886.

354,001. Printing Telegraph Instrument; Aloys Wirsching, Brooklyn, N. Y. Filed July 10, 1886. The invention relates to improvements on patent No. 286,667, Oct. 16, 1883.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

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A Weekly Review of Current Progress in Practical Electricity

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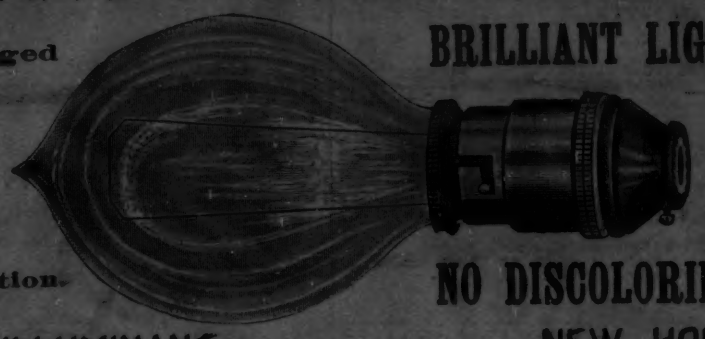

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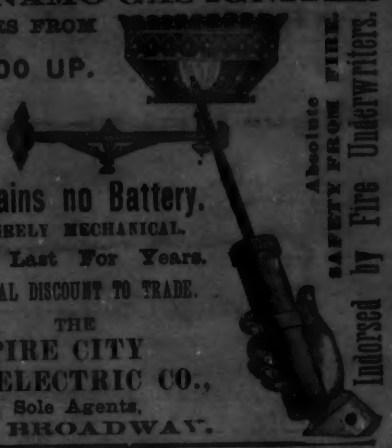

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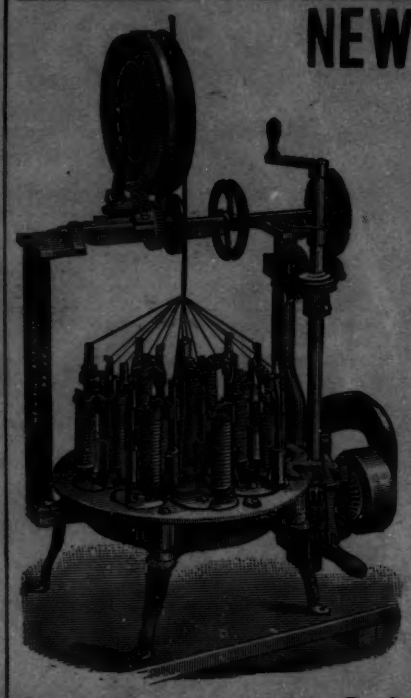

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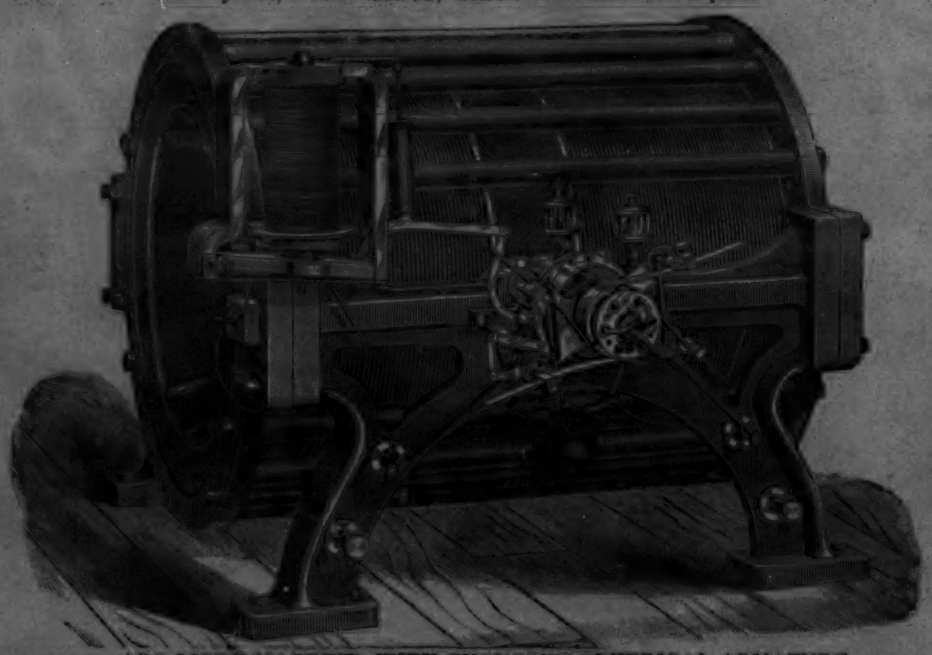

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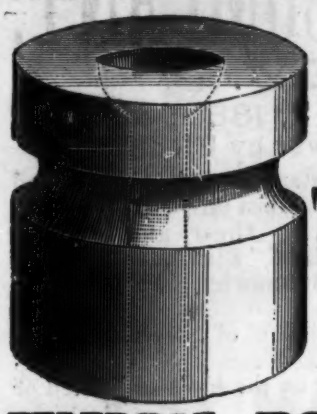

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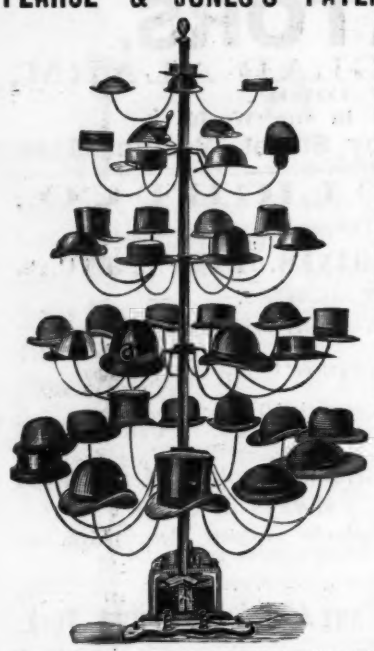

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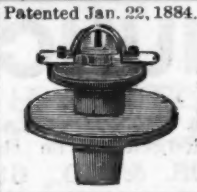

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Can be attached to **any kind** of heating apparatus ever made. Rooms may be kept at any temperature desired, thereby saving fuel, discomfort, ill health, the cracking of wood-work, furniture and pictures, and the danger of fire by over-heating, the thermometer in the room automatically governing the temperature. It is invaluable in Public Buildings, Private Residences, Business Offices, Hospitals, Churches, Schools, Conservatories, Factories, etc. Please send for Illustrated Catalogue **"W."**

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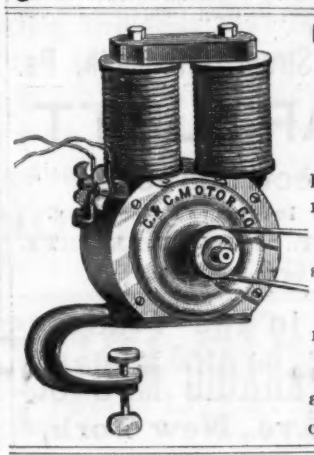

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This company is now prepared to furnish motors of ⅛ horse-power and upwards of unrivaled efficiency, convenient in form, neat in appearance, cheap and durable.

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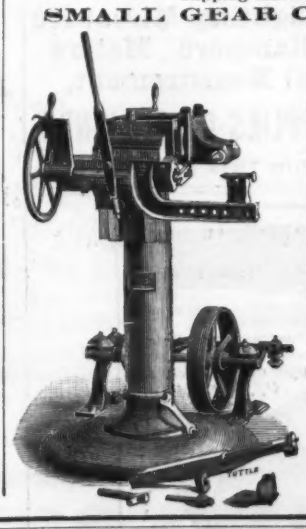

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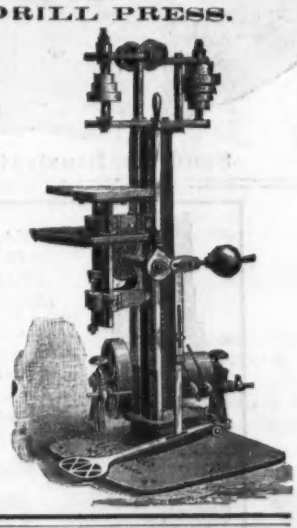

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ELECTRICAL SUPPLIES OF ALL KINDS.

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Does not deteriorate, and for underwater or underground is the most Reliable and Durable.
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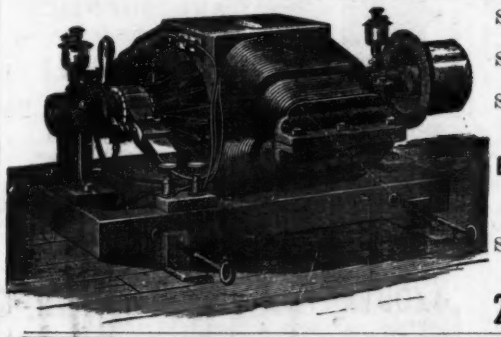

Size A, capacity 20 sixteen c. p. lamps. **Price $160.**

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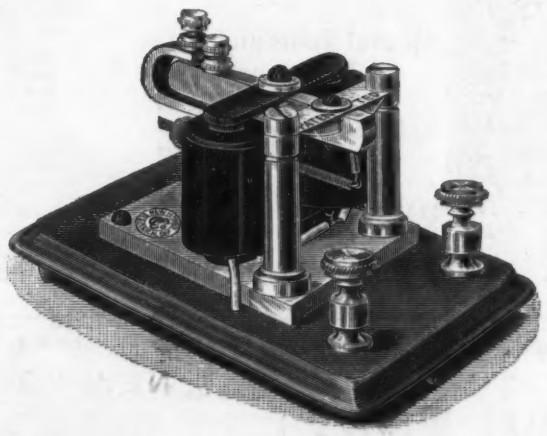

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We caution the trade against infringements of this Sounder, as we have the sole right for the use of the Torsion Spring on Sounders.

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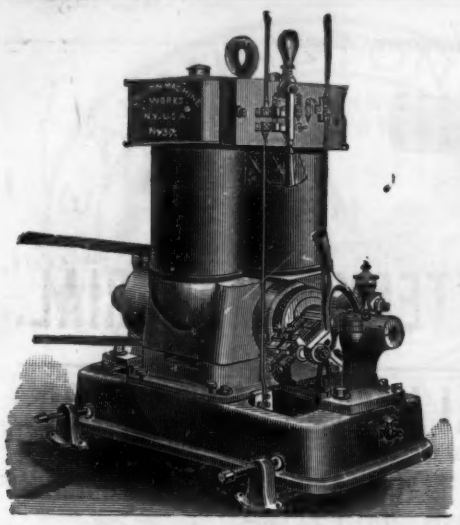

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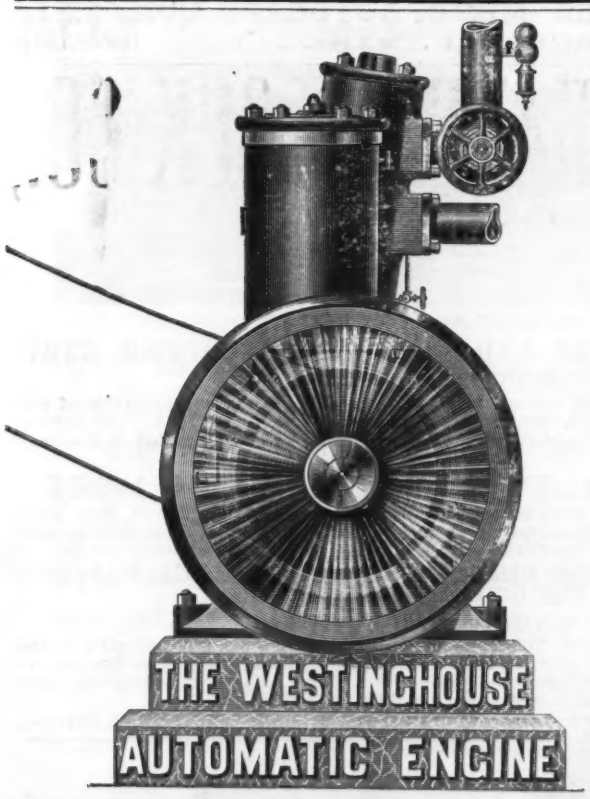
THE EDISON ELECTRIC LIGHT COMPANY,

By EDWARD H. JOHNSON, President.



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Sales List for November, 1886.

			H. P.
South Side E. L. Co		Pittsburgh, Pa.,	150
" "	2d order.	" "	150
Union Switch and Signal Co	6th order,	" "	75
East End E. L. Co	2d order,	" "	75
" "	3d order,	" "	75
Brush Electric Light Co	2d order,	Buffalo, N. Y.,	60
McConway & Torley	2d order,	Pittsburgh, Pa.,	60
Winona Paper Co	4th order,	Holyoke, Mass.,	60
N. Y. & Manhattan R. E. Co.		New York,	60
Mather Electric Co		Hartford, Ct.,	60
" "	2d order,	" "	60
Jefferson City E. L. Co		Jefferson City, Mo.,	60
Wahoo E. L. Co		Wahoo, Neb.,	60
J. C. Livingston & Co		Little Falls, N. Y.,	45
Weidman Silk Dyeing Co		Paterson, N. J.,	45
Miller, Broudy & Co		Alexandria, La.,	45
E. L. McLain Mfg. Co	2d order,	Greenfield, O.,	45
Van Deventer & Horne		Plainfield, N. J.,	35
"The Public Ledger"	2d order,	Philadelphia, Pa.,	35
" "	3d order,	" "	35
" "	4th order,	" "	35
" "	5th order,	" "	35
E. Balbach & Son	14th order,	" "	35
Wolff & Hamaker		Chambersburg, Pa.,	35
Imperial Guano Co		Norfolk, Va.,	35
Chandler & Price		Cleveland, O.,	35
Wabash, St. L. & Pacific R. R.	2d order,	Ft. Wayne, Ind.,	35
Barnes Bros		Maquoketa, Ia.,	35
A. J. Mullen		Selma, Ala.,	35
Brainard & Shephard		Albany, N. Y.	25
Henry Warden		Philadelphia, Pa.,	25
Crown Mills		Marcellus, N. Y.,	25
S. R. Cain		Bristol, Vt.,	25
Wabash, St. L. & Pacific R. R.	3d order,	Ft. Wayne, Ind.,	25
Minneapolis Gas Light Co		Minneapolis, Minn.,	25
" "	2d order,	" "	25
Thos. Henshall		Paterson, N. J.,	15
E. Balbach & Son	15th order,	Newark, N. J.,	15
Gas Engine & Power Co		New York,	15
Roulleaux, Dugage & Co	9d order,	Suresnes, Fr.,	15
Shickle, Harrison & Howard	2d order,	St. Louis, Mo.,	15
McCord, Ford & Co		Colfax, W. T.,	15
Decatur Furnace Co		Decatur, Ala.,	15
Lawrence Machine Shop	15th order,	Lawrence, Mass.,	10
" "	16th order,	" "	10
N. W. Wait, Son & Co		Sandy Hill, N. Y.,	10
F. S. Cole		Grundy City, Ia.,	10
Union Pacific R. R	2d order,	Omaha, Neb.,	10
Geo. C. Howard		Philadelphia, Pa.,	5
Merritt W. Burwell		New Haven, Ct.	5
Westinghouse Electric Co	3d order,	Pittsburgh, Pa.,	5
Lawrence Machine Shop	17th order,	Lawrence, Mass.,	5
" "	18th order,	" "	5
J. A. Diamond		Indianapolis Ind.,	5
F. J. Yandle		Santa Rosa, Cal.,	5
Aberdeen Packing Co		Astoria, Or.,	5
Total, 56 engines			1,975

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Get our Prices before purchasing elsewhere. Estimates furnished on Special Instruments and Machinery.

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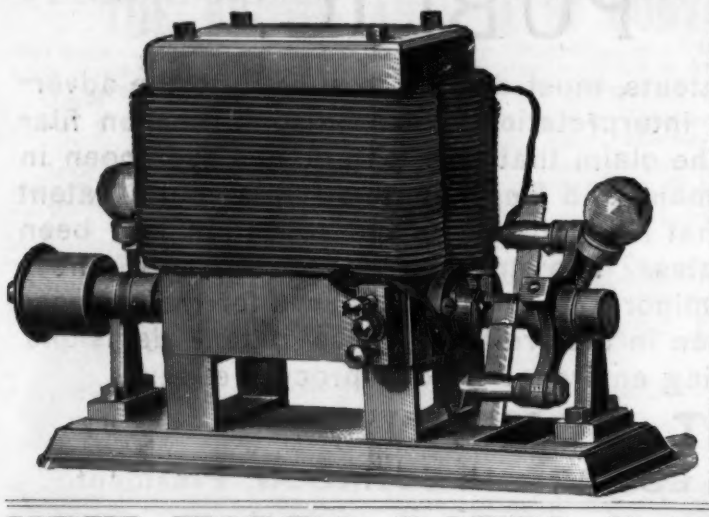

THE NO. 1 PLATING MACHINE.

This machine is designed for the use of Platers and others who do not need a large machine.

Having first-class facilities for the manufacture of these machines, we are enabled to make them at the lowest possible cost, and are now selling them at prices lower than ever before offered.

Every machine warranted, and if any machine is found after a fair trial not to be satisfactory, it can be returned.

NEW VOLTA PAVIA BATTERY.

IN 6 BY 8 GLASS JAR,

Price $3 per cell.

Electromotive force on high resistance - - - 2.2 Volts.

Current on low resistance - - - - - - 12 to 15 amperes.

This size of Volta Pavia Battery, constructed on the same plan as the large Volta Pavia cells now extensively in use for electric lighting, is now ready. It uses the regular 6 by 8 glass jar, and those having such jars need only get the other parts of the battery. It is admirably adapted to all kinds of electrical work previously done by the Bunsen, Grove, Smee and Fuller batteries, such as actuating electro-magnets, running small motors, electro-plating, etc. It is believed to give a larger current than any constant cell of the same size ever devised. Five cells will run one 5 c. p. lamp; eight will run one 8 c. p. lamp; fifteen will run one 16 c. p. lamp.

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Complete Steam Plants for Electric Light and Power.

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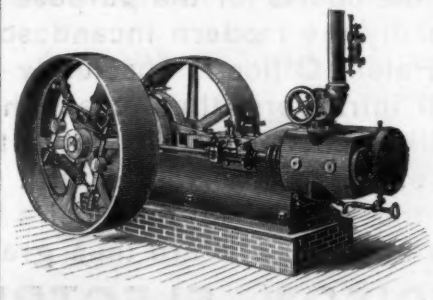

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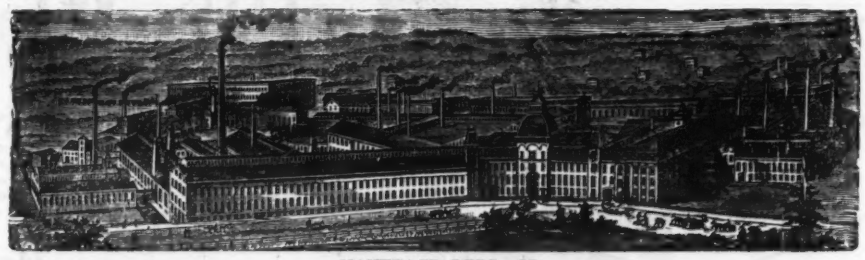

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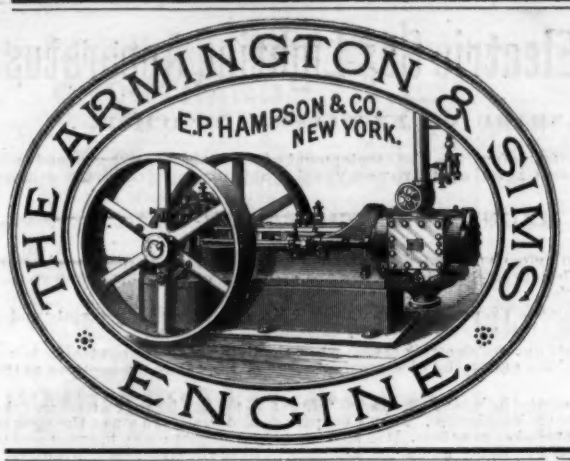

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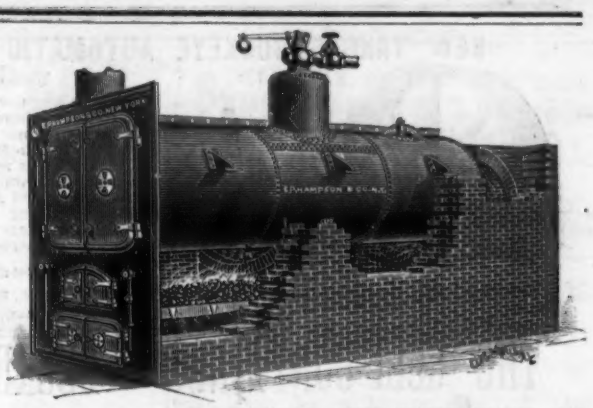

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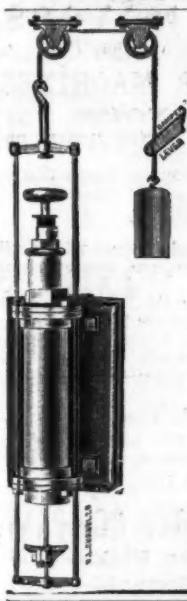

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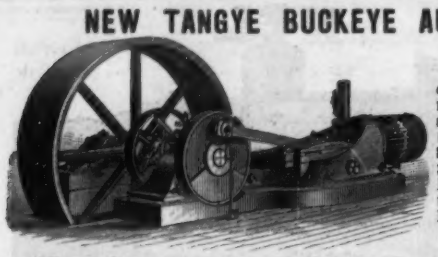

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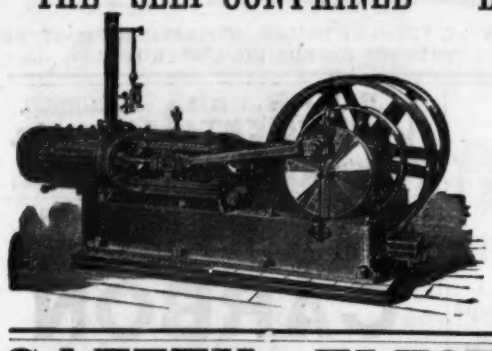

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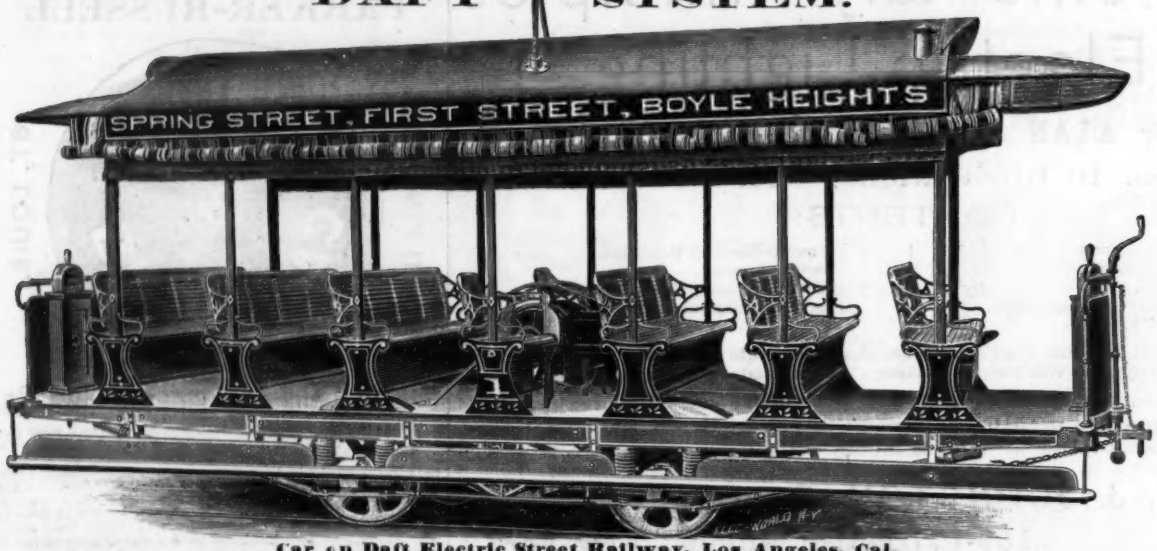

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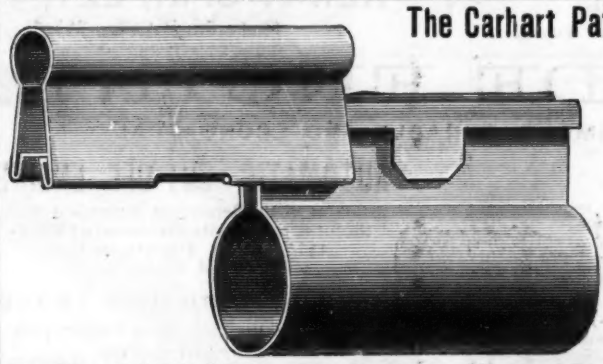

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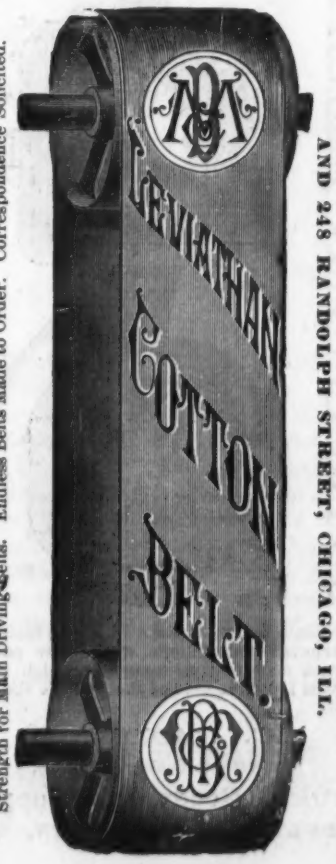

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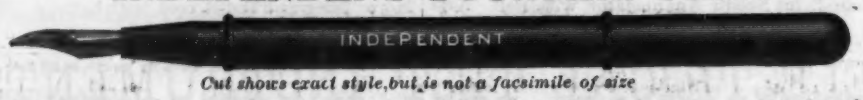

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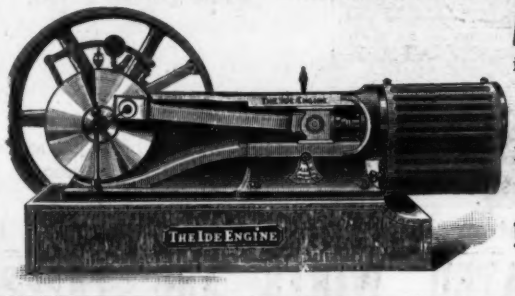

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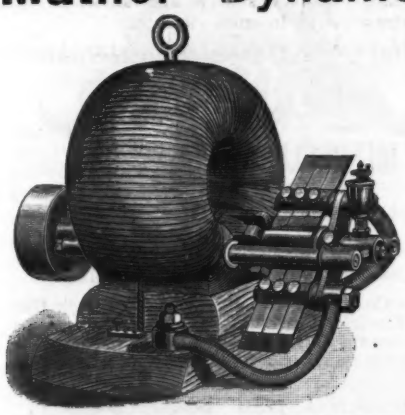

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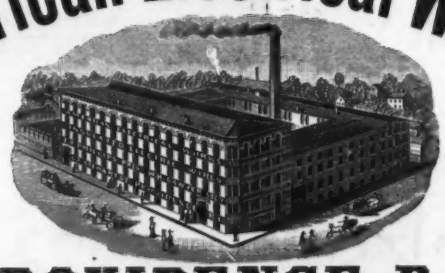

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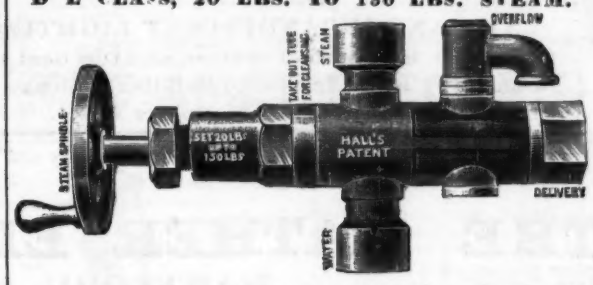

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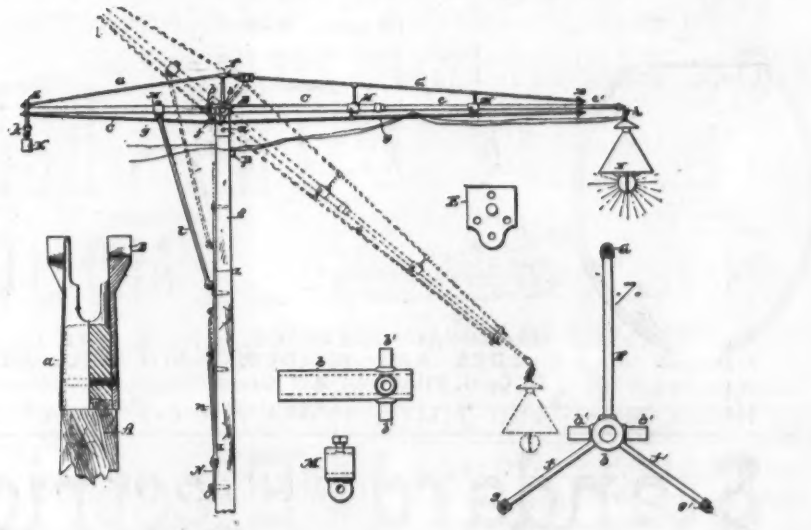

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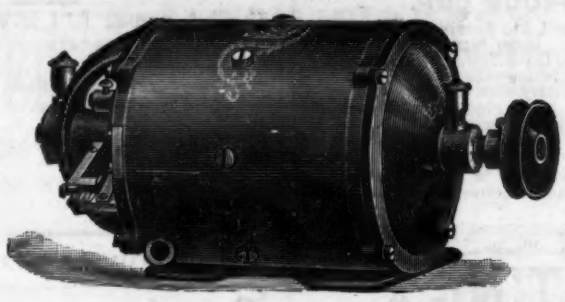

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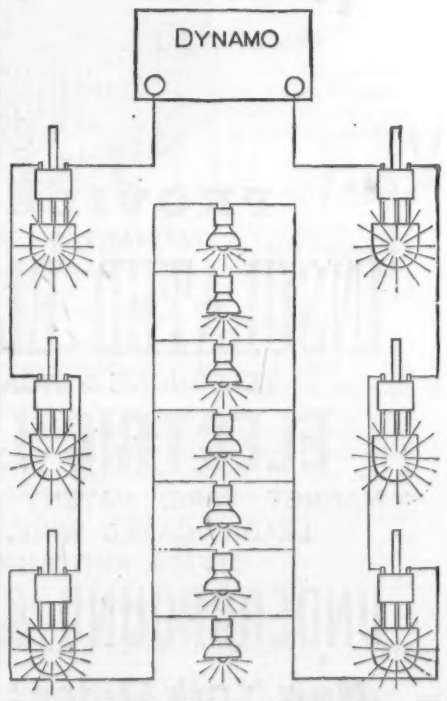

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Fig. 259.

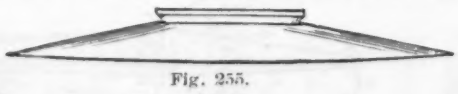

Fig. 255.

Fig. 1013.

Fig. 1018.

Fig. 1017.

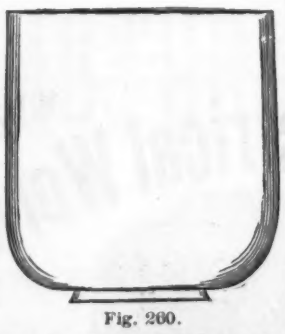

Fig. 260.

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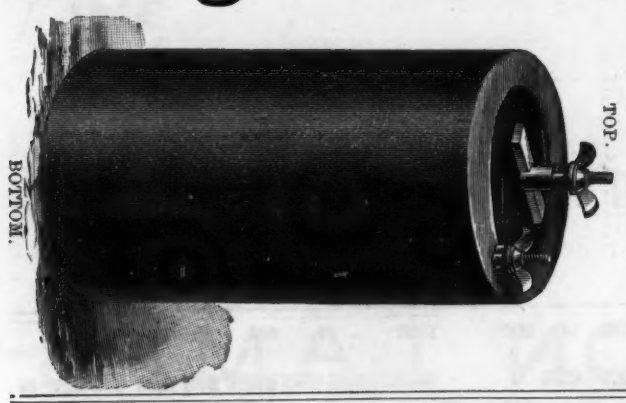

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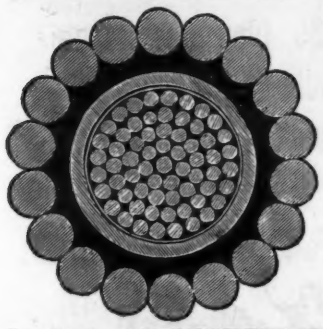

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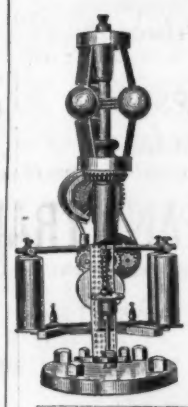

Instantaneous in its action. Purely automatic. Maintains a uniform current. Keeps the lights at a normal brilliancy. Prevents fires and accidents from overcharged wires. Economizes power and carbons. Is the only perfect Governor made.

Terms, 30 Days. If not Satisfactory, no Sale.

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The Amet Brush Adjuster controls from one to full capacity of arc lights and is superior to all others.

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These batteries have each about 1.8 volts. The Per-Oxide Battery is intended for severe open-circuit work. Our Dry Battery is **something entirely new**. It is put up in a sealed cell; **no fluid to spill**; can be used in **any position.**

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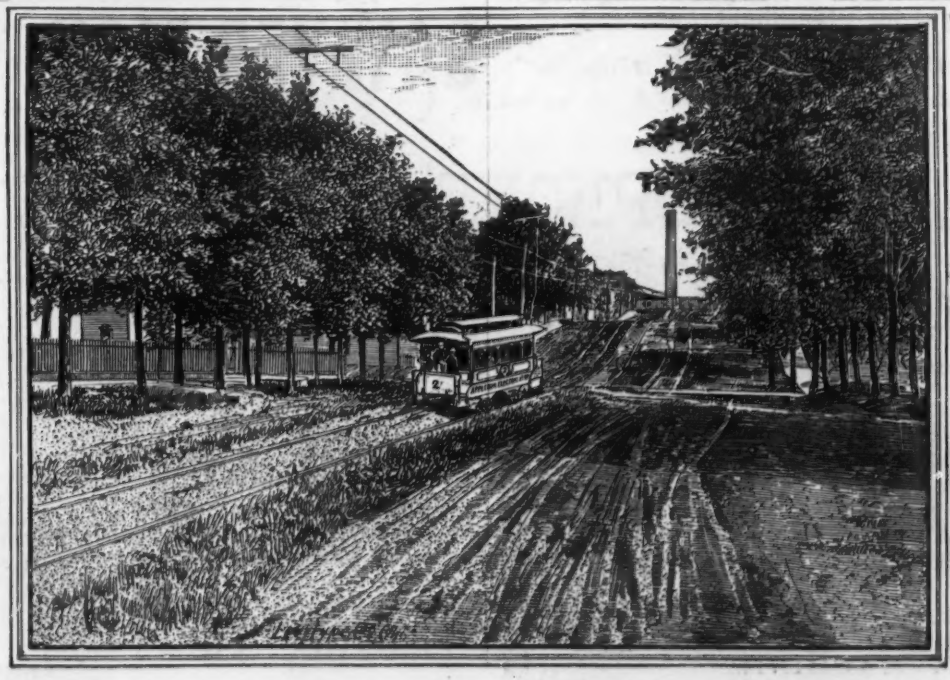

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Made of Best Materials and in the Best Style of Workmanship.

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From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.

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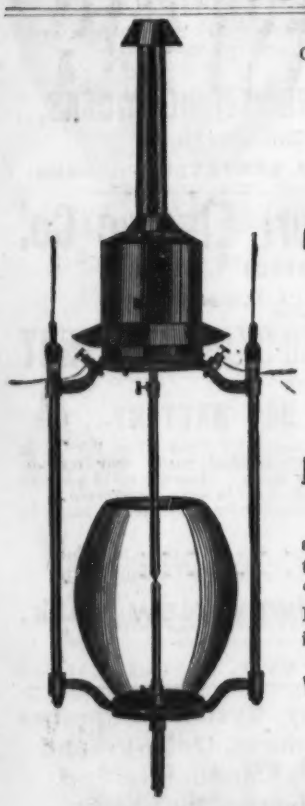

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J. A. Jenney Dynamo-Electric Machines

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Perfectly Automatic and Self-Regulating Jenney Arc Lamps

The Jenney Dynamo has no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Jenney Lamp. We were awarded the three first medals at the "Southern Exposition" at Louisville, Ky., in 1883: 1st. Best Dynamo for Arc Lighting. 1st. Best Electric Lamp for Arc Lighting. 1st. Best System for Arc Lighting.

We have the only perfect working Headlight for Steamboats, etc.

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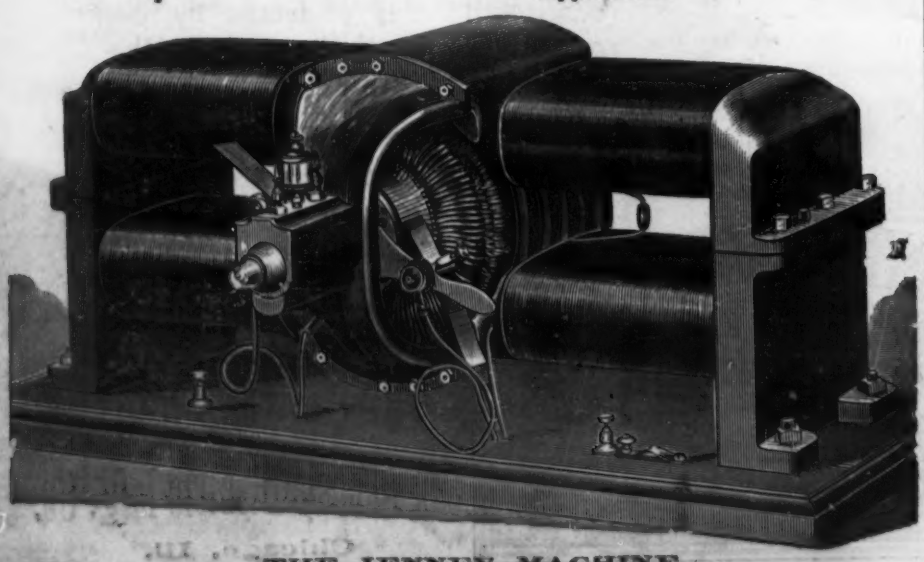
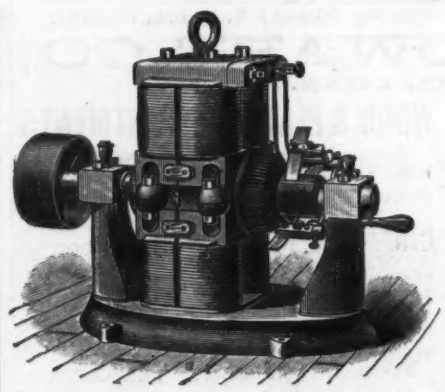


THE JENNEY MACHINE.

THE WATERHOUSE SYSTEM OF ARC LIGHTING IS

Economical in Power Required.



The Regulation is Automatic and Instantaneous, admitting of the turning off of lights and of running the Generator in complete short circuit without heat or injury to the machine.

The Dynamo runs practically noiseless and without sparks on commutator, and those who have seen the system are **Enthusiastic in its Praise.**

THE WATERHOUSE ELECTRIC MFG. CO.,
HARTFORD, CONN.
Factory: Colt's West Armory.

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Licensed by and succeeding to the Commercial Business of the
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The DYNAMO of this Company is AUTOMATIC in its regulation, and will Maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the Lights in Circuit. Our LAMP will NOT BLACKEN, and will MAINTAIN its CANDLE-POWER during its Guaranteed Life

Plans and Estimates Furnished for all Kinds of Incandescent Lighting.

ESTIMATES FURNISHED FOR THE THOMSON-HOUSTON SYSTEM OF ARC LIGHTING.

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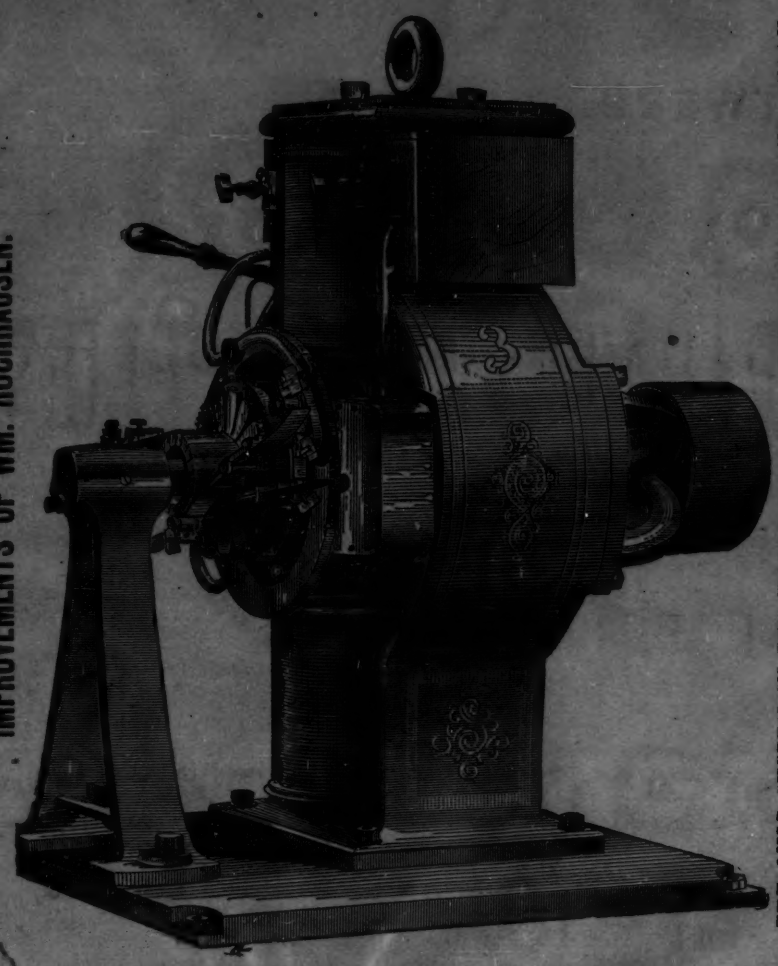
WE ARE THE SOLE OWNERS OF ALL THE VALUABLE PATENTS AND IMPROVEMENTS OF WM. HOCHHAUSEN.



THE ONLY SYSTEM IN THE WORLD CAPABLE OF WORKING ARC AND INCANDESCENT LIGHTS ON THE SAME CIRCUIT SUCCESSFULLY.

THINLY PERFECT AUTOMATIC REGULATION MACHINE IN THE WORLD.

Our Machine occupies the least space.
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Insulated Wire Manufacturers.

"ATLANTIC" PURE WHITE LEAD

IS THE BEST WHITE LEAD MADE FOR

WATERPROOFING INSULATION

ON ACCOUNT OF ITS

SUPERIOR BODY AND UNVARYING UNIFORMITY.

It is especially adapted for Electric Light Wires, and Manufacturers of Electrical Wires should use the "ATLANTIC" for the desirable qualities mentioned.

IT IS GREATLY SUPERIOR TO ZINC WHITE FOR USES NAMED.

ATLANTIC WHITE LEAD AND LINSEED OIL CO., 287 Pearl Street, New York.

SELF-CONTAINED STEAM ENGINES.

Stationary or Semi-Portable.

High Standard Maintained. Prices greatly Reduced. Write for New Illustrated Catalogue No.

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THE IMPROVED METHOD OF PRODUCING POWER.

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Saves One-Half the Fuel and Defies all Competition.

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INCANDESCENT A SUCCESSFUL COMPETITOR AGAINST GAS

AND GASOLINE FOR

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Accomplished by our entirely new method of long-distance lighting in practical operation at St. Louis for the last two years

HEISLER ELECTRIC LIGHT CO., 809 to 817 S. 7th Street, St. Louis, Mo.,

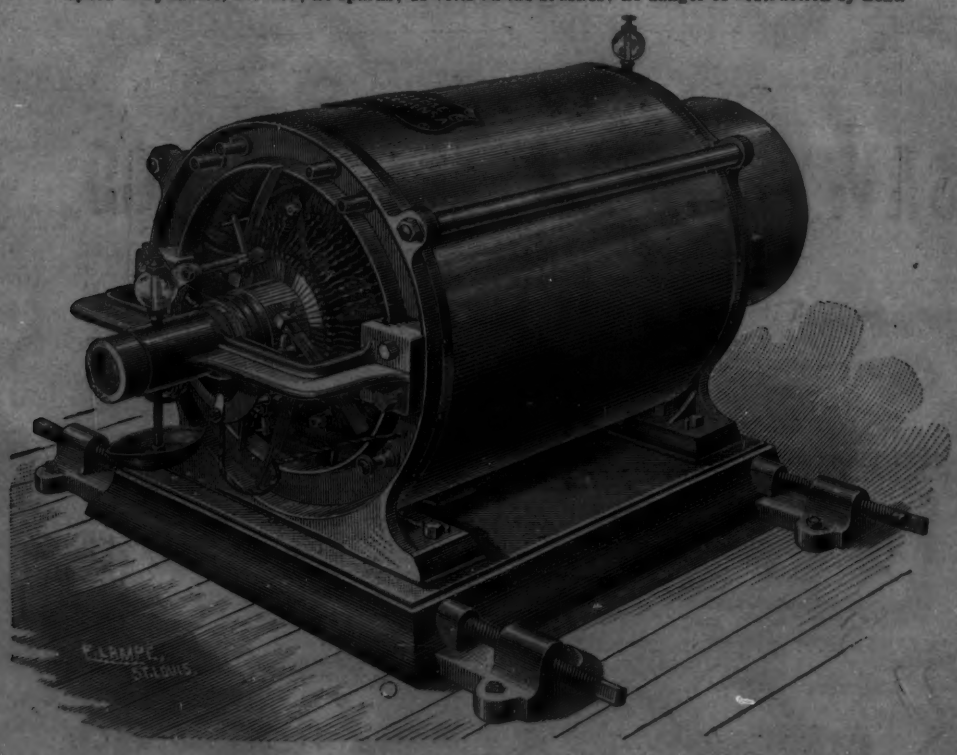
Is now prepared to furnish and put up complete Central Station Plants to supply the long-felt demand for

LIGHTING STREETS BY INCANDESCENT.

We call the special attention of ARC LIGHT COS., GAS COS., MUNICIPAL AUTHORITIES (particularly in Towns without a Gas Plant), and parties having steam or water-power, to this system.

LOCATION OF POWER OR DISTANCE TO LIGHT NEED NOT BE CONSIDERED.

Speed of Dynamos, 600–800; no sparks; 45 volts on the brushes; no danger of destruction by heat.



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Lamps are not connected in groups.

We guarantee 7 30-Candle Lights to the Horse-power, Distributed at any Desired Place on a 15-mile Circuit of No. 7 (Amer. Gauge) Wire; Lights approaching the Arc Light in color and brilliancy and maintaining their rated Candle Power undiminished during the life of the Lamp.

PERFECT AUTOMATIC REGULATION.

WE RESPECTFULLY REFER TO

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Where 150 30-candle street lamps are running on a 15-mile circuit and 150 mercial lights with a 42 horse-power engine, and a fuel consumption

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Using 150 30-candle commercial ligh

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1,000 30-candle lights

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, Durable, Economical, Steady, Brilliant and Penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

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The Jenney Incandescent Dynamo is Self-Regulating, and Permits the Turning On and Off of one or all of the Lamps at will.

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For all purposes where power is required.

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We Furnish the Only Complete and Perfect System of Electric Lighting.

MACHINES FOR ARC LIGHTING,

Giving lights of 1,200, 2,000, 3,000, 4,000 and up to 100,000 candle-power. Our No. 8 machine gives 65 lights of 2,000 candle-power with about 45 horse-power.

Over Twenty Different Styles of Arc Lamps,

For indoor and outdoor use, and for tower lighting.

MACHINES FOR INCANDESCENCE LIGHTING

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For Incandescence Lighting and for Electric Motors.

INCANDESCENCE LIGHTS ON ARC CIRCUITS

by means of the Brush Multiple Series Cut-out. We are the only parties entitled to furnish this system of lighting, as Mr. Brush's patent is the only one granted in the field. All other users are infringers.

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...s are the purest and best made. We have the largest and most fully equipped carbon ...e world, and our prices are very low.

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...ture of the Brush Electric Motors, and shall soon be prepared ... forty horse-power. In many locations these are the ... will be largely used by Lighting Companies and others

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No other system is as economical in installation and maintenance.
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THE SYSTEM COMPRISES { Arc Lights of various sizes. Arc and Incandescent Lights from one dynamo and circuit. Incandescent Lights of various sizes from special dynamo for central station lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates by Experts.

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Condensing, Non-Condensing and Compound. Close Regulation and ...omic ...arant... Also...

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Is now Equipping Street Railroads with

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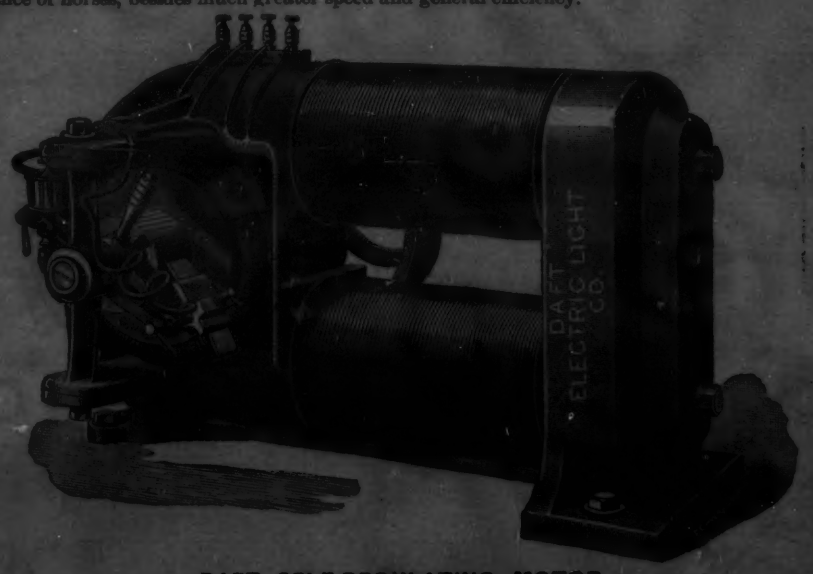
TO SUIT LOCAL CONDITIONS,

Together with convenient and safety appliances to insure constant running without specially skilled attendance.

See Manager's Report, in Catalogue, of over one year's constant running, including a severe winter, and on roads having gradients of 350 ft. per mile, showing marked economy over the performance of horses, besides much greater speed and general efficiency.



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This company is also rapidly adding to its already important central power installations and isolated plants, the result of the completeness and undoubted success of those which have already withstood severe tests of enduring qualities, uniformity of speed and economic value.

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